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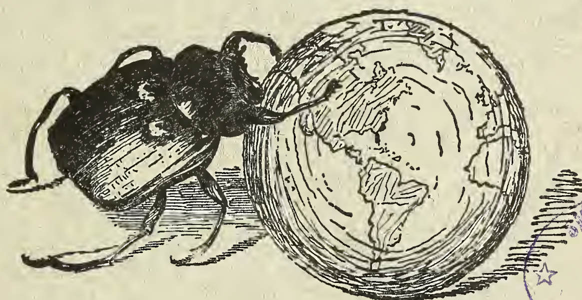

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SOME INSECTS OF THOREAU'S WRITINGS

By J. S. Wade

It was near Concord, Massachusetts, on a beautiful summer afternoon that two companions, associates in Federal economic entomology, drove rather slowly along the winding wood-road which leads through the forest undergrowth down the gentle declivity toward Walden pond. Stopping their auto at a convenient place, they then proceeded on foot a short distance through the fragrant pine woods toward the spot, immortal in American literature, where Henry David Thoreau, he whom Channing had called the "Poet-Naturalist," had erected his now famous hut. As their feet, brushing aside the litter of the forest floor, drew them nearer to the goal of their journey, their tones became more hushed, their steps grew slower and their manner more subdued. Before them on the gentle slope, irregularly bounded on either side by slight depressions, surrounded by quiet trees, and amid peaceful gauze-like fringe of undergrowth, was to be seen a large pile of weather beaten stones—the cairn—placed there by devoted and reverent hands of pilgrims from the ends of the earth, upon the exact spot where once had stood the humble hut where the great thinker had "lived one of his lives."

Standing there in the quiet woods beside this shrine, with the soft rays of the afternoon sun reflecting from the pond surface, brokenly through the fragrant pine trees upon them a message of peace, the quiet and serenity of the place made quick appeal, and met instant response. Sensitive to the touch of beauty, and be-

coming dimly aware that the spot whereon they stood might be termed holy ground, they doffed their head-coverings with unspoken accord and enwrapped in an eloquent silence allowed the tranqillity of the scene to have full sway and work its magic upon them.

Why attempt to describe what was before their eyes when Thoreau himself already has delighted to dwell in matchless words over and over again upon its changing loveliness! While the natural scenery was there before them in all its exquisite beauty, yet the man who loved to paint unparalleled word pictures of every phase of its glory at all seasons of the year was not there to give to them his interpretation of the passing hour. Because of this there appeared in their imaginations to be some indefinable quality lacking from the hue and fragrance of the day. It might be as if they were to "be satisfied with the dews of morning or evening without their colors or the heavens without their azure."

It was a passing whimsical fancy, but the comrades remarked to each other that if only there could have been made possible such a capricious reversal of time as that of visiting this place when it had Thoreau's living presence, what an epochal interest such an event would have possessed to every one concerned! For instance, how gratified he would have been if one from an after generation might only have conveyed to him some message or hint of his growing fame in future years! How much more endurable such a vision of the future years might have made his obscurity, apparent literary failure, and the depreciation of him by his contemporaries.

After a little while the comrades strolled down to the pond side talking in low tones as they walked of the one whose steps had so often trod the path along that gentle slope. Gathering up from the edge of the water some stones suitable for the purpose, they each carried one up the slope and added it to the cairn, which by accretions of similar stones already was higher than their heads. Remembering an old comrade of boyhood days, who, though far away in miles was yet very near in sympathy and appreciation of Thoreau, one of the party added still another stone to the heap in the name of this absent friend, in an

attempt to express as it were by proxy some of the affection and admiration always manifested by him for the great naturalist. Memories of that friend and of boyhood hours they had spent happily together in reading aloud from "Robinson Crusoe" and "Walden" tended by the same token to enhance the charm of the spot and to add luster to the graciousness of its serenity. It is oftentimes a matter of extreme difficulty for some people to converse dispassionately concerning Thoreau. The theme brings up to them a wealth of tender reminiscence of a golden time in youth when Thoreau in his Walden woods and Robinson Crusoe on his desert isle were ideal heroes and made overwhelming appeal to boyish nature. Even memories of the records of the gentle St. Francis of Assisi with the birds of Bevagna may not recall for them any more loving pictures from that time when life was fresh and new, than do those of Henry Thoreau, the serene nature lover of Concord with his birds and fishes, insects and flowers.

At some distant time in the past, possibly during some storm, a large tree had fallen within the area formerly used as the door yard of the hut; its branches and projecting roots were long since gone and the trunk itself had become considerably decayed, yet its presence there still added somehow to the spot a touch of peculiar appropriateness and tended as it were to give it the one final ambrosial touch needed to make realistic the words: "We can not help being struck by the seeming though innocent indifference of Nature. . . . Like a true benefactress, the secret of service is its unchangeableness." How Thoreau would have delighted in having that old tree lie there on that spot! What aphorisms and soliloquies its presence would have provoked from him!

> "We lack but open eye and ear
>   To find the Orient's marvels here;
> The still small voice in autumn's hush,
>   Yon maple wood the burning bush."

Soon the comrades gravitated to the old tree and seated side by side upon its trunk they drank in anew of the fragrance of the woods and as it were thought aloud to each other of many things. Variable was the vein of fancy. The well was deep and there was little to draw with. They became painfully affected by

the consciousness of the truth that "If thou hast wanderings in the wilderness and findest not Sinai, 'tis thy soul is poor." However, perchance for them it were "better that the primrose by the river's brim be a yellow primrose and nothing more than that it be something less."

> "The beauty of old Greece or Rome
> Sung, painted, wrought, lies close at home;
> We need but eye and ear
> In all our daily walks to trace
> The outlines of incarnate grace,
> The hymns of gods to hear."

Much of the bark of the old tree trunk long ago had gone, but here and there fragments were still clinging to the surface of the nearly bare worm-scarred trunk, and presently the comrades, with instincts unerringly true to entomological tradition, were deftly pulling away bits of it here and there and peering hither and yon beneath it and debating with each other as to the possibility of finding insect specimens therein. Soon, sure enough, a tiny chestnut brown beetle was brought kicking and struggling into light, to the unconcealed exultation of its finder, and, after some animated debate as to its identity, it was consigned to the ever-present cyanide bottle. The occurrence of this specimen, later determined as *Tenebrioides nana* Melsh., of the Coleopterous family Ostomidæ, turned the thoughts and conversation of the comrades to a discussion of the various records by Thoreau of observations upon insects. It was vaguely apprehended by them at the moment that he had written much upon the subject, but it was not until later that a growing interest in this phase of his writings led as opportunity afforded to a more careful examination of Thoreau's published works in the Library of Congress in Washington, and then only was it clearly realized how very much work he really had done upon the subject.

There have been made several special subject studies of Thoreau's works, in fact it has been a favorite avocation within the past few decades, on part of students and admirers of Thoreau, to assemble and publish pertinent and characteristic extracts from his writings, especially from his voluminous Jour-

nal, containing his records for twenty-four years from 1837 to 1861 on various phases of Nature or upon objects or subjects of general interest. Probably some of the best known of these might be indicated in the series painstakingly compiled by Harrison Gray Otis Blake, entitled ''Early Spring in Massachusetts,'' 1881; ''Summer,'' 1884; ''Winter,'' 1888; ''Thoreau's Thoughts,'' 1890, and ''Autumn,'' 1892. Others of somewhat similar scope and equal interest which might be indicated are ''Thoreau's Calendar,'' 1909, by Anne Russell Marble; ''Notes on New England Birds,'' 1910, by F. H. Allen, and ''Through the Year with Thoreau,'' 1917, by Herbert W. Gleason.

In view of the quantity of recorded observations left by him pertaining to entomological subjects, the enquiry seemed pertinent to those interested in this phase of his work as to whether or not any attempt had been made to segregate and publish any of this material in separate form. Curiously enough, however, it has been found that nothing of this kind on the subject of insects has as yet appeared in print, though a compilation of the more important references to insects in his Journal was commenced some years ago by F. H. Allen. This work was discontinued with the Journal entry for January 6, 1853, and the material, though unpublished, was very courteously made accessible to the writer by him. It seems probable that at some distant time in the future there will be sufficient demand for it on the part of entomologists and others to warrant the labor of preparation of such a compilation. Meanwhile it may be of possible interest to the entomological fraternity and to lovers of Thoreau to learn in a general way something of the extent and character of his entomological references.

It has been therefore for the benefit of those of the fellowship of doubting Thomas, who, perhaps without giving much thought to the matter, have supposed that Thoreau really had not written very much on entomology, and, yet, who have not made an effort to settle their doubts in the obvious way, that the present writer has spent considerable time in making an analytical reading of his works from beginning to end, and, among other things, in the course of the reading, to index each and every reference of whatever brevity or completeness pertaining to insects. On the com-

TABULATION OF INSECT REFERENCES IN THOREAU'S WRITINGS

	Coleoptera	Diptera	Hemiptera	Hymenoptera	Lepidoptera	Orthoptera	Siphonoptera	Thysanura	Trichoptera	Misc.	Ephemeridae	Odonata	Euplexoptera	Neuroptera	Plecoptera	Total Insects	Total Birds
Week	1	7	1	12	1	10	1			13						46	60
Walden	7	4	3	7	5	4			1	20						51	74
Maine Woods	2	26				4				3	2					37	68
Cape Cod	2	2		2	2					2						10	36
Excursions	8	4	2	5	14	14			1	17						65	136
Miscellanies	1	6		3		1				2						13	21
Fam. Letters	4	4	1	2		2			1	3						17	41
Jour., v. 1	2	5	4	7	1	22	1		1	6						49	87
Jour., v. 2	17	14	3	18	11	44		3	1	22		1				134	211
Jour., v. 3	14	11	3	37	6	13	1	2	1	17						105	342
Jour., v. 4	26	27	26	45	15	61		2	4	42		6				254	694
Jour., v. 5	26	25	15	42	29	38		2	6	58	2	5				248	769
Jour., v. 6	17	22	17	31	44	26		12		47	7	11	1	1		236	1,009
Jour., v. 7	16	10	14	16	25	19		5	1	64	2	5		1		178	1,101
Jour., v. 8	8	16	8	30	14	8		7	1	34	3	8			2	139	578
Jour., v. 9	10	19	6	42	28	18			1	40	1	2		1	1	169	411
Jour., v. 10	10	8	5	16	12	22		1		23		1			1	99	773
Jour., v. 11	10	18	6	23	20	27	1	1		40						146	435
Jour., v. 12	16	24	6	32	26	17		1		62		6		1	1	254	569
Jour., v. 13	29	22	20	27	30	15		4		31	1	7			2	186	492
Jour., v. 14	6	5	2	7	12	17			1	24		2				76	226
	232	279	142	404	295	382	4	40	20	570	18	54	1	4	7	2,512	8,433

pletion after some months of this self-imposed work of index-making, he has prepared therefrom the following tabular statement from which exact data can be obtained indicating the extent of Thoreau's entomological writings as arranged by the orders of the insects considered in each of the works.

It will be noted that there are in all slightly over 2,500 references pertaining to matters entomological, and, in this connection, it is interesting to compare with these figures a similar notation of the ornithological references made at the same time which gave a total of 8,433 references. The figures, however, are eloquent as to the relative claims of his insects and his birds upon his attention.

Lest it should be felt that the mere extent of Thoreau's entomological writings is being dwelt upon here with undue emphasis, it might be well to add, in explanation, that some degree of enumeration of figures seems necessary properly to visualize their scope in order that their really unique character might be correctly apprehended. Here too the thoroughness of the survey must indicate the breadth and extent as well as the wealth of the landscape.

In any consideration of Thoreau's records of his natural history observations it should be borne in mind that he was ever more of a poet than a scientist, and that he lived before the advent of modern intensive methods of scientific research, hence, while he was a keen observer and practical recorder of facts, he was essentially a "hunter of the beautiful," and much of the time in his writings he ignored the "exclusive attitude of scientists who restrict their studies to the actual object, and so neglect its subjective effects." The entomologist therefore will be disappointed who expects to find in Thoreau's writings many long technical descriptions of insects, or detailed ecological data presented in orderly arrangement in any thing like accordance with present-day usage in the preparation of technical papers or in dealing with such themes. As stated, the reader who desires such may find a plethora in any of our modern technical periodicals. In compensation for these omissions, however, there are everywhere manifestations in profusion of the ideality of the poet-mystic added to the sympathetic vision of the old-time naturalist.

He represents that rare type: the poet and philosopher of Nature. Critics who have noted such omissions have stated that Thoreau's gifts were entirely emotional and reflective and that while he was a "sensitive feeler" he was deficient in powers of observation. His Journal, however, affords abundant evidence of the keen and delicate response of his senses and his heart both to more evident as well as less evident phases of Nature. "Sights and sounds thrilled him not less than the lofty visions and ideals which they symbolized. . . . The birds and insects spoke messages of purity and faith to his soul as well as to his ear."

The scope and character of Thoreau's references to entomological topics only may be fully appreciated by making quotations therefrom in number and length far beyond the limits of this paper. A few brief extracts pertaining to the more common orders of insects may suffice, however, to give some degree of apprehension of his style and methods of dealing with such subjects. In making selection of these passages especial effort is made to include not those which merely impart dry entomological facts—these can be found in abundance elsewhere—but, especially to select only those which might be considered representative of the character and trend of the records of his thoughts during many refreshing hours of serene communion with Nature—hours in which, as he said, the "Spirit of the Lord blessed me, and I forgot even to be good." At such times the true harvest of his daily life was "a little star-dust caught, a segment of the rainbow which I have clutched."

In the order Orthoptera there are 382 references in Thoreau's writings. The greater number of these are brief references to some phase of the activities and habits of grasshoppers or crickets. It is especially noteworthy that throughout the series of volumes there may be found over and over again references of one kind or another to sounds made by crickets. Many of these by whimsical twist of thought appear to have been written in Thoreau's happiest vein, as instance the following:

"The creaking of the crickets seems at the very foundation of all sound. At last I cannot tell it from a ringing in my ears. It is a sound from within, not without. You cannot dispose of it by listening to it. In proportion as I am stilled I hear it. It

reminds me that I am a denizen of the earth.'' (Journal, v. 2, p. 306), and ''. . . the creak of crickets, a June sound now fairly begun, inducing contemplation and philosophic thoughts—the sultry hum of insects.'' (June 8, 1856, Journal, v. 8, p. 372.) Again, ''The fall crickets, or is it the alder locust?—sings the praises of the day'' (August 25, 1856, Journal, v. 9, p. 22), and ''Heard the first cricket as I go through the warm hollow, bringing round the summer with his everlasting strain'' (May 24, 1857, Journal, v. 9, p. 378), or ''I see one of those peculiarly green locusts with long and slender legs on a grass stem, which are often concealed by their color. What green, herbaceous, graminivorous ideas he must have! I wish my thoughts were as seasonable as his'' (September 6, 1857, Journal, v. 10, p. 26).

In more recent years a number of highly interesting accounts have been written of the habits and songs of American Orthoptera, notably those papers by H. A. Allard, W. S. Blatchley, S. H. Scudder, R. E. Snodgrass, M. P. Somes, and others. Valuable and stimulating as these are, it may be doubted if any of these writers ever approached the subject with a wider sympathy or achieved a fuller appreciation of the interrelations with all nature of his little musicians, than did Thoreau. After listening to the shrilling of crickets and noting the method by which it was produced, he says: ''Thus the sounds of human industry and activity—the roar of cannon, blasting of rocks, whistling of locomotives, rattling of carts, tinkering of artisans, and voices of men—may sound to some distant ear like an earth-song and the creaking of crickets.'' (October 18, 1857, Journal, v. 10, p. 107.) Again, on another occasion he writes: ''As I stand on the bank there, I find suddenly that I hear, low and steady, under all other sounds, the creak of the mole cricket by the riverside. It has a peculiarly late sound, suggestive of the progress of the year. It is the voice which comes up steadily at this season from that narrow sandy strip between the meadow and the water's edge. You might think it issued from that small frog, the only living thing you see, which sits so motionless on the sand. But the singer is wholly out of sight in his gallery under the surface. *Creak, creak, creak, creak, creak, creak, creak, creak.* It is sound associated with the declining year and recalls the moods of that

season. It is so unobtrusive yet universal a sound, so underlying the other sounds which fill the air—the song of birds, rustling of leaves, dry hopping sound of grasshoppers, etc.—that now, in my chamber, I can hardly be sure whether I hear it still, or remember it, it so rings in my ears.'' (August 11, 1858, Journal, v. 11, p. 95.) Emerson in the obituary notice of Thoreau, read at his funeral, refers to the quaintness of his reference to the ''Z-ing'' of the locusts. Perhaps he had in mind the following passage: ''That fine z-ing of locusts in the grass which I have heard for three or four days is, methinks, an August sound and is very inspiriting. It is a certain maturity in the year which it suggests. My thoughts are the less crude for it. There is a certain moral and physical sluggishness and standstill at midsummer.'' (August 2, 1859, Journal, v. 12, p. 274.) It appears that he loved to dwell upon these sounds in relation to the dying year: ''The shrilling of the alder locust is the soldier that welds these autumn days together. All bushes resound with their song, and you wade up to your ears in it. Methinks the burden of their song is the countless harvests of the year—berries, grain, and other fruits.'' (August 25, 1860, Journal, v. 14, p. 62.)

After all, it is as has been pointed out by Bradford Torrey, ''The effect of music upon the soul depends as much upon the temper of the soul as upon the perfection of the instrument,'' and it is easy to apprehend that the homely creaking of the crickets brought to Thoreau a nobler and more significant message than has been brought by the grandest oratorio to many another person.

The Order Hymenoptera is represented by 404 references, the greater number of which pertain to the various species of bees and of ants. He was especially fond of watching the former at their work, and, if space permitted, many paragraphs could be cited dealing with them in a manner somewhat after the following:

''Examining, I find that every flower has a small hole pierced through the tube, commonly through calyx and all, opposite the nectary. This does not hinder its opening. The Rape of the Flower! The bee knew where the sweet lay, and was unscrupulous in his mode of obtaining it. A certain violence tolerated by nature.'' (August 23, 1856, Journal, v. 9, p. 16.)

Or, again, similar to this: "The old *Salix sericea* is now all alive with the hum of honey-bees. This would show that it is in bloom. I see and hear one bumblebee among them, inaugurating summer with his deep bass. May it be such a summer to me as it suggests. It sounds a little like mockery, however, to cheat me again with the promise of such tropical opportunities. I have learned to suspect him, as I do all fortune-tellers. But no sound so brings around the summer again. It is like the drum of May training." (May 1, 1858, Journal, v. 10, p. 393.)

Probably no portion of Thoreau's writings has been more widely quoted, or more generally known, than the description given in "Walden" of the immortal battle of the ants. It is like unto a contest among Titans. Says William Lyon Phelps: "It is as if he had turned a prodigious lens upon the struggling insects, and they had become monsters. No one could have written the account of the World War among the ants unless he had been saturated with Homer, for the whole history is not only epic in range, breadth and intensity, but is peculiarly Homeric in the elevation of the heroes. . . . Such an account is not only thrilling in itself but its irony is unmistakable. It is a kind of Universal History of Mankind."

"One day when I went out to my wood-pile, or rather my pile of stumps, I observed two large ants, the one red, the other much larger, nearly half an inch long, and black, fiercely contending with one another. Having once got hold they never let go, but struggled and wrestled and rolled on the chips incessantly. Looking further, I was surprised to find that the chips were covered with such combatants, that it was not a *duellum*, but a *bellum*, a war between two races of ants, the red always pitted against the black, and frequently two red ones to one black. The legions of these Myrmidons covered all the hills and vales in my wood-yard, and the ground was already strewn with the dead and dying, both red and black. It was the only battle which I have ever witnessed, the only battlefield I ever trod while the battle was raging; internecine war; the red republicans on the one hand, and the black imperialists on the other. On every side they were engaged in deadly combat, yet without any noise that I could hear, and human soldiers never fought so resolutely. I watched a couple that were fast locked in each other's embraces,

in a little sunny valley amid the chips, now at noon-day prepared to fight till the sun went down, or life went out. The smaller red champion had fastened himself like a vise to his adversary's front and through all the tumblings on that field never for an instant ceased to gnaw at one of his feelers near the root, having already caused the other to go by the board; while the stronger black one dashed him from side to side, and, as I saw on looking nearer, had already divested himself of several of his members. They fought with more pertinacity than bull-dogs. Neither manifested the least disposition to retreat. It was evident that their battle-cry was conquer or die. In the meanwhile there came along a single red ant on the hill-side of this valley, evidently full of excitement, who had either dispatched his foe, or had not yet taken part in the battle; probably the latter, for he had lost none of his limbs; whose mother had charged him to return with his shield or upon it. Or perchance he was some Achilles, who had nourished his wrath apart and had now come to avenge or rescue his Patroclus. He saw their unequal combat from afar—for the blacks were nearly twice the size of the reds—he drew near with rapid pace till he stood on his guard within half an inch of the combatants; then, watching his opportunity, he sprang upon the black warrior, and commended his operations near the root of his right fore leg, leaving the foe to select among his own members; and so there were three united for life, as if a new kind of attraction had been invented which put all other locks and cements to shame. I should not have wondered by this time that they had their respective musical bands stationed on some eminent chip, and playing their national airs the while, to excite the slow and cheer the dying combatants. I was myself excited somewhat even as if they had been men. The more you think about it, the less the difference. And certainly there is not a fight recorded in Concord history, at least, if in the history of America, that will bear a moment's comparison with this, whether for numbers engaged in it, or for the patriotism and heroism displayed. For numbers and for carnage it was an Austerlitz or Dresden. Concord Fight! Two killed on the patriot's side, and Luther Blanchard wounded! Why here every ant was a Buttrick—'Fire! For God's sake fire!'—and thousands shared the fate of Davis and Hosmer. There was not one hireling there. I have

no doubt it was a principle they fought for, as much as our ancestors, and not to avoid a three penny tax on their tea; and the results of this battle will be as important and as memorable to those whom it concerns as those of the Battle of Bunker Hill, at least.

''I took up the chip on which the three I have particularly described were struggling, carried it into my house, and placed it under a tumbler on my window-sill, in order to see the issue. Holding a microscope to the first-mentioned red ant, I saw that, though he was assiduously gnawing at the near foreleg of his enemy, having severed his remaining feeler, his own breast was all torn away, exposing what vitals he had there to the jaws of the black warrior, whose breastplate was apparently too thick for him to pierce; and the dark carbuncles of the sufferer's eyes shone with ferocity such as war only could excite. They struggled half an hour longer under the tumbler, and when I looked again the black soldier had severed the heads of his foes from their bodies, and the still living heads were hanging on either side of him like ghastly trophies at his saddle-bow, still apparently as firmly fastened as ever, and he was endeavoring with feeble struggles, being without feelers and with only the remnant of a leg, and I know not how many other wounds, to divest himself of them; which at length, after half an hour more, he accomplished. I raised the glass, and he went off over the window-sill in that crippled state. Whether he finally survived the combat, and spent the remainder of his days in some Hotel des Invalides, I do not know; but I thought his industry would not be worth much thereafter. I never learned which side was victorious, nor the cause of the war; but I felt for the rest of that day as if I had my feelings excited and harrowed by witnessing the struggle, the ferocity and carnage, of a human battle before my door.

''Kirby and Spence tell us that the battles of the ants have long been celebrated and the date of them recorded, though they say that Huber is the only modern author who appears to have witnessed them. 'Aeneas Sylvius,' say they, 'after giving a very circumstantial account of one contested with great obstinacy by a great and small species on the trunk of a pear tree,' adds that 'this action was fought in the pontificate of Eugenius the Fourth, in the presence of Nicholas Pistoriensis, an eminent lawyer, who

related the whole history of the battle with the greatest fidelity.' A similar engagement between great and small ants is recorded by Olaus Magnus, in which the small ones, being victorious, are said to have buried the bodies of their own soldiers, but left those of their giant enemies a prey to the birds. This event happened previous to the expulsion of the tyrant Christiern the Second from Sweden. The battle which I witnessed took place in the Presidency of Polk, five years before the passage of Webster's Fugitive-Slave Bill.'' (Walden, Riverside ed., pp. 355–361.)

In looking through his published Journal one can often note that he never ceases to be profoundly impressed by the apparent vagaries to be found in Nature, and some of his deductions therefrom are at times a bit startling in their whimsicality: ''Saw some green galls on a goldenrod three quarters of an inch in diameter, shaped like a fruit or an Eastern temple, with two or three little worms inside, completely changing the destiny of the plant, showing the intimate relation between animal and vegetable life. The animal signifies its wishes by a touch, and the plant, instead of going on to blossom and bear its normal fruit, devoted itself to the service of the insect and becomes its cradle and food. It suggests that Nature is a kind of gall, that the Creator stung her and man is the grub she is destined to house and feed. The plant rounds off and paints the gall with as much care and love as its own flower and fruit, admiring it perchance even more'' (July 30, 1853, Journal, v. 5, p. 349) ; and, ''In the wood-paths I find a great many of the Castile-soap galls, more or less fresh. Some are saddled on the twigs. They are now dropping from the shrub oaks. Is not art itself a gall? Nature is stung by God and the seed of man planted in her. The artist changes the direction of Nature and makes her grow according to his idea. If the gall was anticipated when the oak was made, so the canoe when the birch was made. Genius stings Nature, and she grows according to its idea'' (Journal, v. 7, p. 10) ; and, ''Observed some of those little hard galls on the high blueberry, packed or eaten into by some bird (or possibly mouse), for the little white grubs which lie curled up in them. What entomologists the birds are! Most men do not suspect that there are grubs in them, and how secure the latter seem under these thick

dry shells! Yet there is no secret but it is confided to some one.'' (January 18, 1856, Journal, v. 8, p. 116.)

Of the 295 references to the Order Lepidoptera, the greater number refer to various species of butterflies and moths common in that portion of New England area, and comprise in the main records of varying length and scope on the life-history, habits, and distribution. There are quite vivid accounts of metamorphoses from larva to adult of some of the more abundant species of the family Saturniidae, such as the Io, the Polyphemus, the Cecropia, and Luna moths. In these too we find that rare gift of words, that union of simplicity and freshness, which lend a charm to the writing almost independent of the ideas or the images conveyed and leaves a haunting melody, as ''. . . a yellow butterfly —how hot! This meteor dancing through the air.'' This reminds one of another of his somewhat similar comparisons ''The blue-bird carries the sky on his back,'' or still another—hinting of some of the compensations in the life of a land surveyor: ''As I was measuring along the Marlborough road, a fine little blue-slate butterfly fluttered over the chain. Even its feeble strength was required to fetch the year about. How daring, even rash, Nature appears, who sends out butterflies so early! Sardanapalus-like, she loves extreme and contrasts.'' (April 28, 1856, Journal, v. 8, p. 315.) Concerning this originality and freshness of view, John Greenleaf Whittier wrote to his friend Daniel Ricketson under date of August 17, 1875, after Thoreau had been many years in his grave, ''I was reading the other day in Thoreau. . . . What a rare genius he was; to take up his books is like a stroll in the woods or a sail on the lake, the leaves rustle, and the water ripples along his pages.''

None of the 232 references to the Order Coleoptera contain data of any especial interest nor may there be found in them any information not already well known to most students of insects. Like the other references their appeal lies solely in the unexampled attitude taken by him toward the objects of his observation: ''The telegraph harp sounds strongly to-day, in the midst of the rain. I put my ear to the trees and I hear it working terribly within, and anon it swells into a clear tone, which seems to concentrate in the core of the tree, for all the sound seems to proceed from the wood. It is as if you entered some world-famous

cathedral, resounding to some vast organ. The fibres of all things have their tension, and are strained like the strings of a lyre. I feel the ground tremble under my feet as I stand near the post. This wire vibrates with great power, as if it would strain and rend the wood. What an awful and fateful music it must be to the worms in the wood! No better vermifuge were needed. No danger that worms will attack this wood; such vibrating music would thrill them to death.'' (September 23, 1851, Journal, v. 3, p. 13.)

Or, ''The east side of the Deep Cut is nearly bare, as is the railroad itself, and, on the driest parts of the sandy slope, I go looking for Cicindela—to see it run or fly amid the sere blackberry vines—some life which the warmth of the dry sand under the spring sun has called forth; but I see none. I am reassured and reminded that I am the heir of eternal inheritances which are inalienable, when I feel the warmth reflected from this sunny bank, and see the yellow sand and the reddish subsoil, and hear some dried leaves rustle and the trickling of melted snow in some sluiceway. The eternity which I detect in Nature I predicate of myself also. How many springs I have had this same experience! I am encouraged for I recognize this steady persistency and recovery of Nature as a quality of myself.'' (March 23, 1856, Journal, v. 8, p. 222–3.)

''At Nut Meadow Brook the small-sized water-bugs are abundant and active as in summer. I see forty or fifty circling together in the smooth and sunny bays all along the brook. This is something new to me. What must they think of this winter? It is like a child waked up and playing at midnight. . . . At night, of course, they dive to the bottom and bury themselves, and if in the morning they perceive no curtain of ice drawn over their sky, and the pleasant weather continues, they gladly rise again and resume their gyrations in some sunny bay amid the alders and the stubbles. I think that I never noticed them more numerous, but the fact is I never looked for them so particularly. But I fear for their nervous systems, lest this be too much activity, too much excitement. The sun falling thus warmly for so long on the surface of the brook tempts them upward gradually, till there is a little group gyrating there as in summer. What a funny way they have of going to bed! They do not take a light and

retire upstairs; they go below. Suddenly it is heels up and heads down, and they go down to their muddy bed and let the unresting stream flow over them in their dreams. They go to bed in another element. What a deep slumber must be theirs, and what dreams, down in the mud there. So the insect life is not withdrawn far off, but a warm sun would soon entice it forth. Sometimes they seem to have a little difficulty in making the plunge. Maybe they are too dry to slip under. I saw one floating on its back, and it struggled a little while before it righted itself. Suppose you were to plot the course of one for a day; what kind of a figure would it make? Probably this feat too will one day be performed by science, that maid of all work. I see one chasing a mote, and the wave the creature makes always causes the mote to float away from it. I would like to know what it is they communicate to one another, they who appear to value each other's society so much. How many water-bugs make a quorum? How many hundreds does their Fourier think it takes to make a complete bug? Where did they get their backs polished so? They will have occasion to remember this year, that winter when we were waked out of our annual sleep! What is their precise hour for retiring? . . . Ah, if I had no more sins to answer for than a water-bug!'' (January 24, 1858, Journal, v. 10, pp. 255–256.)

In reading Thoreau's writings one is impressed by the fact that a great many passages therein, some of them couched in language of rarest beauty, contain thoughts which we recognize immediately as our own, but which somehow we have never been able adequately to formulate into words, and we become vastly encouraged to see them thus robed and adorned. Then too we are stimulated to find that another has been able through the humble dew drop on the grass blade or the ''Golden and coppery reflections from a yellow dor-bug's coat of mail in the water'' to find comfort and to receive from them a message that through all human vicissitudes the good God is still running the world. Said Emerson at Thoreau's grave: ''The charm of personality perishes with the memory of those who have felt its spell; the inspiration of the Thinker is the deathless inheritance of the race.'' We are somehow reminded of this by such passages as these: ''Have not the fireflies in the meadow relation to the stars above, Etincelant?'' ''Do not the stars, too, show their light for

love, like the fireflies?'' (June 16, 1852, Journal, v. 4, p. 109), and ''The fireflies in the meadows are very numerous, as if they had replenished their lights from the lightning. The far-retreated thunder-clouds low in the southeast horizon and in the north, emitting low flashes which reveal their forms, appear to lift their wings like fireflies; or it is a steady glow like the glow-worm.'' (June 21, 1852, Journal, v. 4, p. 129.) Or, ''glow-worms . . . look like some kind of rare and precious gem, so regularly marked, far more beautiful than a uniform mass of light would be'' (August 8, 1857, Journal, v. 10, p. 4). Again, ''What were the fireflies light, if it were not for darkness? The one implies the other.'' (June 25, 1852, Journal, v. 4, p. 146.)

While there are only fifty-four references to the order Odonata, selection may be made from them which are typical of one who dwells serenely in a kingdom of fancy and in which come moments freighted with enviable richness of imagination: ''. . . the abundant small dragon-flies of different colors, bright-blue and lighter, looped along the floating vallisneria, make a very lively and gay appearance. I fancy these bright loops adorn or set forth the river like triumphal arches for my procession, stretching from side to side.'' (August 1, 1856, Journal, v. 8, p. 441.) Again, of dragon-flies he says: ''How lavishly they are painted! How cheap was the paint! How free was the fancy of their Creator!'' These remind one of another of his apothegms: ''Better trivial days with faith than the fairest ones lighted by sunshine alone.'' In another place he discusses in somewhat like vein, ''If the day and the night are such that you greet them with joy and life emits a fragrance like flowers and sweet scenting herbs, is more elastic, more starry, more immortal —that is your success.''

Thus the magic associated with the name of Henry Thoreau has its charm for thousands of devoted admirers of his writings both in America and in Europe, and with the passing of the years the number of these is steadily growing. More and more apparent becomes the truth of Emerson's statement about him that ''The country knows not yet, or in the least part, how great a son it has lost.'' This growing interest and appeal is evinced not only by the demand for and steady sale of his works in the various tasteful and attractive editions issued at frequent inter-

vals by his publishers, but also is shown in the ever-increasing number of books, periodical and other publications concerning him, his personal history, his associates, his environment, the fascinating inconsistencies of his philosophy, and his attitude toward and outlook upon the universe. We could spare many ponderous tomes of natural history disquisitions rather than a passage of his from "Walden" regarding the tiny insect upon the forest floor, for it more nearly penetrates in sympathy and discernment into the heart of things than does many a ream of tedious and involved technical detail! "As I stand over the insect crawling amid the pine needles on the forest floor, and endeavoring to conceal itself from my sight, and ask myself why it will cherish those humble thoughts, and hide its head from me who might, perhaps, be its benefactor, and impart to its race some cheering information, I am reminded of the greater Benefactor and Intelligence that stands over me the human insect."

And, again: "Every one has heard the story which has gone the rounds of New England, of a strong and beautiful insect which came out of the dry leaf of an old table of apple-tree wood, which had stood in a farmer's kitchen for sixty years, first in Connecticut, and afterwards in Massachusetts—from an egg deposited in the living tree many years earlier still, as appeared by counting the annual layers beyond it; which was heard gnawing out for several weeks, hatched perchance by the heat of an urn. Who does not feel his faith in a resurrection and immortality strengthened by hearing of this? Who knows what beautiful and winged life, whose egg has been buried for ages under many concentric layers of woodenness in the dead dry life of society, deposited at first in the alburnum of the green and living tree, which has been gradually converted into the semblance of its well-seasoned tomb—heard perchance gnawing out now for years by the astonished family of men, as they sat around the festive board—may unexpectedly come forth from amidst society's most trivial and handselled furniture, to enjoy its perfect summer life at last!"

And so as the two comrades set that afternoon on the log at Walden and talked to each other of Thoreau and his writings, it was the unspoken thought of both that most can feel with a deep intensity the felicities of such a treasure-house of Nature

and yet be utterly unable to find words with which to give adequate expression to the emotions. The delicious aroma of the pines standing as sentinels about the cairn, the rippling silver of the surface of the little lake, the curving here and there of its green-bordered shores, the hills melting away beyond in gray-blue haze, all united in imparting a message of Eden-like serenity and peace. After such an experience the two comrades knew that they would never cease to remember with delight the charm and fragrance of Walden woods! Nor could they ever cease to remember the concluding message of optimism in the little volume penned on that spot! "Only that day dawns to which we are awake. There is more day to dawn. The sun is but a morning star."

FIG. 1. View of Thoreau's Cairn at Walden.

FIG. 2. View of Walden from Thoreau's Cove, showing Emerson's Cliffs in distance.

THE GENUS MELINAEA HUBNER, WITH A DESCRIPTION OF A NEW SPECIES (LEPIDOPTERA, ITHOMIINAE)

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The genus Melinaea is in much the same case as Mechanitis, on which I have already reported (JOURN. N. Y. ENT. SOC. 32, 145, 1924). The material here discussed is from the same sources, save that less was taken on the Expedition, and series have been short. As in the case of Mechanitis there has never been any systematic study of the genus, although it is of special interest on account of its involvement in many cases of mimicry.

The genus belongs to another tribe of Ithomiinæ, more primitive in having preserved a well formed fore tibia and tarsus, although in two species these reach a marked state of reduction. The characters are: eyes naked, fore wing with middle discocellular vein angled, with a strong medial spur from its angulation, hind wing with lower discocellular straight, and practically continuous with the cubitus, the middle discocellular angled with a spur; Sc and R widely spaced, from their first separation. Fore tibia and tarsus of male distinctly separate, taken together from two fifths as long to somewhat longer than the femur, when shortest with the femur long and almost reaching the eye, as in Mechanitis. Male genitalia characteristic and remarkably uniform, the uncus simple and normal, but with two large chitinous lobes arising from the articulation of the valves, which I will call "dorsal lobes," possibly homologous with the angulate subscaphium of Mechanitis and some other genera. Juxta a wide-open V. Valves slightly asymmetrical, thick, with sinuous ventral and shorter dorsal margin, the apex of the right valve with two strong teeth, of which the upper is usually stronger, the left valve usually with the upper tooth weak, and occasionally even lost. Outer face of valve often continued beyond the teeth as

a thin plate enclosing a pocket between it and the teeth. (Absent in *M. egina.*)

There are no close relatives. Hirsutis and Mechanitis have closely similar patterns, partly no doubt due to mimicry, as parallel variations occur from place to place, but I suspect partly also by inheritance of the original Ithomiinæ pattern. The species with a short fore tibia may be distinguished from Mechanitis by the spur of media of the fore wing, which is attached to the lower discocellular in Mechanitis.

For the determination of species the genitalia are a disappointment. *M. egina* with its variety *paraiya* differs in lacking the apical pocket on the valve, and *comma* has a slightly different dorsal lobe and ædœagus; the remainder show some variation, but so little that it may be individual rather than specific, and I dare not use it with the short series available.

I recognize the following species, some of which may yet be combined:

1. *egina,* Cr., with var. *paraiya* Reak.
2. *lilis* D. & H., with vars. *imitata, dodona, parallelis* and *messatis,* and ab. *flavicans* Hoffm.
3. *scylax* Salv.
4. *ethra* Gdt.
5. *mnemopsis* Berg.
6. *idæ* Fld.
7. *mneme* L., with var. *satevis* D. & H.
8. *mediatrix* Weym., with var. *mauensis* Weym. and ab. *anina* Hänsch.
9. *mœlus* Hew., with vars. *manga cydon* G. & S., *madeira* Hänsch (Stgr. ms.) and perhaps *zamora* Hänsch, and *discurrens* Hänsch, which is insufficiently described.
10. *marsæus* Hew., with vars. *lucifer, divisa, phasiana, oresteo* and perhaps *zamora.*
11. *menophilus* Hew., with vars. *magnifica, zaneka, clara, messenina, mothone, cocana, hicetas, flavosignata* and perhaps *maculosa, discurrens* and *tarapotensis.*
12. *maenius* Hew., with var. *Chincha* Dr.
13. *comma* Fbs.

Of these the first six seem distinct enough, with the remote possibility that *scylax* is a form of *lilis*. *Mediatrix* might possibly be a form of mneme, though that is unlikely as they seem to fly together without mixing at Kartabo, B. G.; and it is also possible that *maëlus* with its form is a local representative of *mediatrix*, although the difference is of pattern and not development of markings merely. All the later species (save the last which has a good structural character) are also under suspicion. I have been unable to recognize *mœonis* Hew.

SYNOPSIS OF THE FORMS HERE RECOGNIZED AS SPECIES

A. Subapical band formed of a continuous patch in cells R_3–M_1 or M_2, divided at most by fine black veins; base of cell Cu_1 solidly yellow. Male fore tibia very short, genitalia without apical pocket on valve .... **egina.**

AA. Subapical band more or less broken into spots, or confined to a single cell; base of cell Cu_1 black, or containing a black spot; valve with well-marked apical pocket and plate.

B. Hind wing with a separate submarginal spot in cell M_2, in line with the others; fore wing with comma-mark in cell Cu_1 fully formed, as usual in Mechanitis, confined between the veins, and connected by a streak from its *upper edge* to the black on the outer margin, which contains a tawny spot beneath. Male fore tibia very short .... **comma.**

BB. Hind wing with submarginal spot in cell M_2, when present, much farther from margin than those below it, frequently fused with postmedial spot; fore wing with comma-mark crossing Cu_1, or else with the black line connecting it with the margin attached to its center, frequently covered with black suffusion. No tawny marginal spot beneath. Fore tibia nearly as long as femur.

C. Hind wing with separate postmedial and submarginal series of spots (or with postmedial spots in contact with cell, or if hind wing is immaculate, with its black border linear and the spot in base of cell Cu_1 of fore wing small, or hind wing suffused with black); front margin of cell of hind wing with a large black patch along its outer part.

D. A conspicuous series of double white marginal spots beneath, or with a conspicuous series of black mar-

* Forms marked with an asterisk are in the collection of Cornell University or my own collection.

† Forms marked with a dagger have been examined in American collections.

ginal triangles toward apex of hind wing; fore wing with a separate yellow (rarely tawny) anal spot.

E. Inner margin of fore wing and base of hind wing almost out to fork of Cu black, hind wing with postmedial and submarginal series of spots recognizably distinct, at least beneath, and with a red submarginal streak in cell M_3 more conspicuous than those below and usually above it.

F. Comma-mark forming an oblique hook, its apex pointing toward anal angle; under side without, or with very few white marginal spots .... **maëlus.**

FF. Comma-mark narrower not so formed; under side with many conspicuous white marginal spots .... **mediatrix.**

EE. Inner margin of fore wing of the reddish ground-color, base of hind wing with practically no black. Hind wing without traceably separate subterminal and postmedial bands .... **mneme.**

DD. Hind wing with border linear, at least toward apex, without white spots. Fore wing usually without yellow anal spot.

E. Fore wing with a conspicuous yellow anal spot, comma-mark large and hooked and spot in base of Cu_1 large, as in maëlus group, hind wing with postmedial line touching cell, but without trace of subterminal spots .... **zamora.**

EE. No separate anal spot, comma-mark and spot in base of cell Cu_1 small and widely separated, hind wing normally with black subterminal patches.

F. Comma-mark in cell Cu_1 large, crossing Cu_1, with a recurrent point aiming at the anal angle, though widely separated from the small base of the cell, unlike zamora .... **marsaeus.**

FF. Comma-mark composed of a nearly round spot, part of which lies above Cu_1, connected at its middle to outer margin by a black streak .... **maenias.**

FFF. Comma-mark entirely confined between Cu_1 and Cu_2 with a fine line connected to its middle .... **menophilus.**

CC. Hind wing normally with a single postmedial band or row of spots, well separated from the cell; when absent with the border not linear below, and with no separate or partly separate black area over outer costal part of cell, but usually with a conspicuous oblique bar at base of cell. Spot in base of cell Cu_1 of fore wing large, frequently with this cell almost solid black.

D. Fore wing with a large black spot in the base of cell Cu_1, extending from 1/3 to 3/5 way to margin, and only separated by a narrow pale streak from the heavy black filling of the outer part of the cell; yellow anal spot usually absent.

E. Spots or black filling in bases of cells M_2 and M_3 similarly lengthened, hind wing with border fairly broad and containing conspicuous white marginal spots, at least below, and with at least traces of a postmedial band .... **lilis.**

EE. A double black spot at end of cell only; hind wing wholly tawny, with only a narrow black border, frequently without white marginal spots above or below .... **scylax.**

DD. Fore wing with only a small black spot in base of cell Cu_1, (when the cell is wholly suffused with black more or less visible below) yellow anal spot present.

E. A single rounded subapical spot in cell R_5, comma-mark in the form of a broad club-shaped bar extending in upper part of cell Cu_1 from margin two thirds way in to cell; antenna wholly black .... **ethra.**

EE. A subapical band or series of spots, in cells M_1 and M_2 as well as R_5; outer part of cell Cu_1 solidly black, obliquely cut off at about half its length, or the cell all black; club of antenna yellow.

F. Cells M_3 and Cu_1 almost solid black, enclosing a rounded spot over Cu_1 widely separated from the postmedial fascia; hind wing with postmedial band rudimentary, and border moderate and even in width; antenna with club only yellow...... **mnemopsis.**

FF. Cell Cu_1 obliquely divided into a yellow base and black outer part, M_3 also yellow at the base, the yellow spot in its outer part sometimes connected with the yellow base.

Hind wing with outer half solid black, and no postmedian fascia. Outer half of antenna yellow .... **idae.**

M. mnasias Hew., **thera** Fld., **tecta** Haensch. The large single marginal spots of these species show plainly that they belong to the second group of the Ithomiinae (Mechanitis and following genera). I strongly suspect that they are Ceratinias.

M. equicola Cr. As already noted (Journ. N. Y. Ent. Soc. 32, 153) this is a Mechanitis obviously the same species as *sylvanoides* G. & S., and *equicoloides* G. & S.

M. egina Cr. This is a well-marked species, both on structure and pattern; the very short fore tibia and tarsus separate it from all except *M. comma*, from which the absence of a pit at the apex of the valve separates it sharply. It is the only species without black in the base of cell Cu_1 of the fore wing. A peculiarly primitive character is that there is frequently a *white* marginal spot in cell Cu, the anal spot of all the other species being formed by the fusion of this spot with the normally yellow or tawny submarginal one.

KEY TO FORMS

A. Hind wing with a large black discal patch .... ***e. egina.**

AA. Hind wing with a narrow border and separate series of discal spots .... ***e. paraiya.**

M. lilis D. & H. I have grouped perhaps too miscellaneous a series of forms under this name, but they appear to be geographical representatives of each other. The way in which *messatis* and *scylax* seem to lie between the more typical *lilis* and *imitata*, is curious, but may be due to a more advanced form taking possession of the center of distribution, and driving the earlier types to the margins. A similar case in North America is the Black Swallowtail, where the central *polyxenes* form is more advanced in pattern than the Central American *stabilis*, the Cuban *asterias*, and Newfoundland *brevicauda*, which closely resemble each other. I have let *scylax* stand as a separate species in the list and key, but very much doubt its distinctness.

I have seen a specimen from Trinidad (determined incorrectly as *tachypetis*) with the yellow postmedial band much widened,

joining broadly to the tawny area in cell Cu_1 and in end of cell; the spot in the base of cell M_3 being wholly lacking, and that in M_2 very short.

KEY TO FORMS

A. Apical half of fore wing black, with at least the submarginal spots white and visible on the upper side.
  B. Spots in outer part of fore wing all white.
    C. Hind wing with a longitudinal black median band..*l. **parallelis.**
    CC. Hind wing with only outer half of band visible......†l. **messatis.**
  BB. Marginal spots only white, the others yellow..............................l. **dodona.**
AA. Apical half of fore wing banded, without white submarginal spots above.
  B. Fore wing with a continuous black stripe from base of costa out through cell and along upper side of Cu_1 half way (or more) to margin..............................l. **imitata.**
    C. Hind wing with a yellow median stripe, as in M. ethra..†ab. **flavicans.**
    CC. Hind wing with ground all concolorous tawny..................***typical.**
  BB. Fore wing with the stripe interrupted at lower side of cell. Postmedial band in typical specimen joining the tawny base, more often separated from it.

M. scylax Salv. Certainly a derivative from the same stock as *M. lilis,* but differing in such definite ways that it seems best to hold it as a species. Godman and Salvin note that it seems to replace the *lilis* forms where it occurs. There is a little variation, mostly in the white submarginal dots, which may be wholly absent in the male, but are present in the female.

M. ethra Gdt. Another derivative from something like *lilis,* but separated by a wide area from which I have seen no representative of the group with a single band on the hind wing. It would not surprise me if intermediate forms were eventually discovered. The wholly black antenna is, I believe, unique in the genus.

M. mnemopsis Berg. A very distinct species, so far as pattern goes, but with the usual complete lack of structural characters. The relation of the spots in cell Cu_1 (visible beneath), and the enlarged subapical spot, suggest a distant connection with *M. ethra,* distorted by mimicry of *Mechanitis ocona.*

M. idae Fld. In this species the banding of the hind wing fails entirely. I put it with the single-banded species which precede it because of the oblique division of cell Cu_1 into black and yellow, as in *egina* and the rounded subterminal spot in cell M_3, similar to *egina, mnemopsis* and *messatis*; there is also no outer cell-spot on the hind wing below. On the other hand there is no trace of the special structures of *M. egina*.

M. mneme L. It is a temptation to unite *mneme* and *mediatrix,* but they fly side by side, apparently without mixing. Granting that they are distinct, *satevis* certainly goes with *mneme,* having an identical fore wing pattern. There is no trace of a postmedial band on the hind wing, save in one specimen in the U. S. National Museum, which shows a complete tawny band from the apical spot to the anal angle, half way between the cell and margin, with which the usual slender tawny streak in cell M_3 is connected.

A similar specimen is also figured (under the equivalent name of *crameri*) in the Transactions of the Entomological Society of London for 1906, Pls. xxiv and xxv, fig. 5. The conspicuous outer cell-spot on the under side of the hind wing, and the general resemblance to *mediatrix* also indicate *mneme* belongs to the two-banded group.

KEY TO FORMS

A. Ground tawny, hind wing black with tawny base and apex, and rarely a tawny stripe........ ***m. mneme.**

AA. Ground deep wing red, hind wing with black border only...... ***m. satevis.**

M. mediatrix Weym. (*mneme* auct.) This is a typical member of the two-banded group, to which all the following species belong. The two bands (postmedial and subterminal) are at least partially separate beneath in all the specimens I have seen, but even if they should unite completely, the black inner border of the fore wing (shared by the following species) would separate it from *mneme*. Var. *mauensis* flies with the type and intergrades with it in British Guiana.

KEY TO FORMS

A. Hind wing almost solidly black........ ***m. mediatrix.**

AA. Hind wing with two distinct bands.

B. Yellow transverse band of fore wing continuous, and not separated from the tawny base.......... **m. mauensis.**
BB. Yellow band divided into two isolated spots.......... **ab. anina.**

M. maelus Hew. This series of upper Amazonian forms has the pattern as well as the color modified by entering into the usual heavily marked, mahogany colored mimicry group of the upper Amazon, with *Mechanitis egaënsis, Ceratinia tigrina* and *Sais zitella.* I have chosen the condition of the pattern in cell Cu_1 of the fore wing as the primary character to separate this and the three following species (or groups of forms) as on the whole least distorted by the various mimetic patterns, which make the color as well as the basal, apical and hind-wing patterns of relatively little significance. In this series not only is the apex generally brown with yellow spots (except in *zamora* and *maeonis,* which very likely may be distinct), but the basal spot in Cu_1 and comma mark are both very large, and together nearly fill that cell. The white marginal spots have almost disappeared, but a few survive in some specimens. *M. zamora* has the fore wing pattern of this type, with the normal coloring of bright tawny and yellow, and the narrow hind-wing border, of the following, while variants of the following are known with a widened border on the hind wing. On the whole it would not be surprising if the present, preceding, and next three series, were all one species.

I have been unable to place several of Haensch's names, as he gives no clue to such details of pattern as seem to me significant, *discurrens* perhaps belongs here, and I include it in the key, as well as *maeonis* Hew., which is supposed to resemble *zamora.* All the material of *zamora* I have seen is from Venezuela, but appears to represent the name fairly. It was determined as *maeonis,* which it does not fit.

KEY TO FORMS

A. Apical part of fore wing solid black.......... **m. discurrens.**
AA. Apical part of fore wing yellow-spotted on black.
B. Hind wing with a linear border, and paler orange-yellow median stripe.......... ***m. zamora.**
BB. Hind wing with marginal triangles.......... **m. maeonis.**
AAA. Ground of apical part of wing shaded with brown.

B. Ground tawny, only two small subapical yellow spots......**m. manga.**
BB. Ground red-brown or mahogany, three larger yellow spots.
C. No yellow postmedially ....***m. cydon.**
CC. A narrow yellow postmedial band....................................***m. maëlus.**
CCC. Medial as well as postmedial area largely yellow, partly divided into two bands..***m. madeira.**

M. marsaeus Hew. I have tried to separate this and the two following series by a small pattern difference, that I hope may be uninfluenced by mimicry, but there is no difference whatever in structure, and all should probably be united. There is parallel variation between the three to a certain extent, and further collecting may show that each mimetic type exists in each species. All have their center of distribution in central Peru, and show there forms resembling more or less closely *Mechanitis mazaeus*. *M. phasiana* is a little peculiar in its mahogany apex, and at first glance suggests the preceding group, but the effect is produced by the enlargement of the apical spots and not by a paling of the ground color. It combines the large apical spots of *divisa* and tawny color of typical *marsaeus*. I have taken it at Puerto Bermudez in eastern Peru, a little out of the normal range of the *Mechanitis egaënsis* coloring.

KEY TO FORMS

A. Apical marks tawny, without yellow.
B. Three normal subapical spots..**m. marsaeus.**
BB. Broad mahogany shades between the veins.................***m. phasiana.**
AA. Apex solid black; no yellow at all above...***m. orestes.**
AAA. Apex black with a yellow subapical band formed of three fused spots.
B. Hind wing with bands fused into a large black patch.............................
....***m. lucifer.**
BB. Two separate bands..**m. divisa.**

M. menophilus Hew. This species is evidently highly variable, but I am not at all certain that all the forms credited to it really belong. Besides forms which may belong to *maenius* and to *marsaeus*, which after all are only superficially distinct and may be all one species, there is a possibility, and even a probability that part of the material in collections standing as *menophilus* is *M. comma*. Besides typical *comma*, described below, which passes for typical menophilus, the specimen figured in the Trans.

Ent. Soc. London, '08, Pl. 33, fig. 1 would appear from the pattern to belong to *M. comma.* Prof. Poulton writes me that there are additional specimens in the Hope Collection—as well as others corresponding to fig. 2 of the same plate, which appear to represent true *mothone.* Their structure has not been examined.

As to true *mothone,* the original figure seems to belong to *M. maenius,* but the type should be examined.

KEY TO FORMS

A. Apex of fore wing solid black, without a subapical band or spots.
- B. Hind wing and basal third of fore wing also black, leaving the tip of the hind wing red.
  - C. Outer half of median area of fore wing yellow .... †**m. messenina.**
  - CC. Median area of fore wing wholly red and black .... †**m.** var. **(mothone?)**
- BB. Hind wing red with slender black margin only .... ***m. zaneka.**
- BBB. Hind wing red, with one or two more or less distinct rows of spots on the disc.
  - C. Spots on hind wing weak, distal boundary of median area of fore wing only slightly irregular .... **m. membrosa.**
  - CC. Spots on hind wing strong; distal boundary of band on fore wing regularly toothed.
    - D. Hind wing with two separate rows of large spots.
      - E. Ground dark brown; border of hind wing widened into spots .... **m. discurrens, m. maculosa.**[1]
      - EE. Ground light tawny; border of hind wing linear .... ***m. menophilus.**
    - DD. Hind wing with the spots fused into a patch .... †**m. cocana.**
    - DDD. Ground dull; band on fore wing very narrow and yellow .... **m. tarapotensis.**[2]

AA. Apical portion of fore wing with yellow or tawny spots.
- B. Outer part of median area and subapical spots of fore wing both yellow .... †**m. flavosignata.**
- BB. Median area wholly tawny.
  - C. Subapical spots also tawny .... **m. magnifica.**
  - CC. Subapical spots yellow .... ***m. hicetas.**

[1] The original descriptions of these forms (compared with *zaneka*) are wholly inadequate. The widened border of the hind wing of discurrens seems to point to a form of maelus.

[2] Also inadequately described.

M. maenius Hew. It is not unlikely that the three forms here listed are variants of *M. menophilus* but there seems to be a tangible difference in the shape of the comma-mark, which crosses the vein above, So far as I have seen specimens or figures, all such forms have a solid black apex of the fore wing, but specimens with subapical spots probably exist.

KEY TO FORMS

A. Base of fore wing and most of hind wing black, leaving a tawny apex to hind wing .... †**m. mothone** (?)

AA. Hind wing with reddish ground, marked with black.

B. Ground wholly tawny; hind wing with two separate rows of spots .... †**m. chinca.**

BB. Ground darker red-brown with a yellow band; hind wing with a black patch .... **m. maenius.**

In specimens of this species which show a definite hind-wing pattern, the marginal spots are triangular on the upper side, but the terminal line beneath seems to be slender.

Melinaea comma, new species.

Superficially this species would not be at all out of place among the forms of *menophilus,* but the minute fore tibia and tarsus will instantly distinguish the male. I have seen only the single form described below, which corresponds to typical *menophilus,* but the species no doubt shows the usual range of variation. Trans. Ent. Soc. Lond. '08, pl. 33, fig. 1 is the only published figure that may with some probability be credited to this species, and will represent that form corresponding to *M. m. mothone,* mimicking *Heliconius melpomene.*

Head and body of the usual pattern, exactly as in menophilus and most other species of the genus; antenna yellow, shortly black at the base only. Fore wing light tawny, of the color of menophilus, with a yellow postmedial region covering the upper half, at least, of cell Cu_1, except at the base; and with a shaded or solid yellow area in the outer third of the cell. Apex solid black, its inner boundary waved across cells M_1 and M_2, *with a sharp tooth in cell* M_3 extending into the yellow area. Basal fourth of costa black, a black spot over radius and extending to the costa shortly before end of cell, with its costal part typically a little farther out than the part in the cell; costal edge black from opposite this spot to the apical black area, a longitudinal elliptical black spot over lower angle of cell, a rounded wedge-shaped spot in middle of basal part of cell, with a nearly round spot opposite its outer end, opposite the fork of Cu; a subtriangular spot in base of cell Cu_1 (cell 2), about equal in size to the four spots last mentioned, or rarely smaller and rounded. Comma-mark formed of an

irregular roundish spot in cell Cu_1, slightly nearer margin than base of cell, *not quite reaching Cu,* and typically not reaching M_3 either, *with its upper end connected* by a streak *to a larger triangular marginal patch,* which narrowly joins the apical black area, and reaches down to the middle of cell Cu_2. Inner margin with a blackish streak, tapering to a point two thirds way out to anal angle. Hind wing concolorous with base of fore wing, with the usual fawn-brown costa and costal hair; postmedial band of a series of spots, the first small and in cell M_1, half way between cell and margin, the next two about as far from cell as from each other, the second wedge-shaped, with apex toward the cell, third an oblique parallelogram, fourth more rounded and a little farther from cell, and last one wedge-shaped, with its tip resting on the inner margin half way out to tip of 3d A (substantially as in *menophilus,* save that the second spot is truncate at its outer end). Subterminal series similar, leaving a tawny band of almost even width between them and the postmedial series; *first spot opposite second postmedial, in cell M_3,* rounded or irregular, not large, *half way between postmedial and margin* (in menophilus, etc., close to tip of postmedial or absent); second and third spots squarish, *with outer end rounded* (normally notched in the other species), the fourth spot a triangular area resting on margin and extending from vein Cu_2 to tip of 3d A. No marginal spots, but fringe blackish.

Under side similar, *fore wing with more or less traces of a diffuse tawny subterminal band,* parallel to outer margin; black triangle at tip of vein Cu_2 and cell Cu_1 *with a tawny center* (absent in the mothone-like form according to Prof. Poulton); hind wing with additional longitudinal black patches from base of inner margin to a third way out on costal side of cell, and with a larger one centering on R, from two thirds way out on cell *to well beyond its tip,* rarely with these two spots fused into a costal band. Last subterminal spot sometimes divided in two parts and not quite reaching margin.

Fore tibia and tarsus of male less than half as long as trochanter and femur (about as long in most species), the tarsus about half as long as tibia. Female with tibia alone as long as femur. Male genitalia with dorsal process gradually tapering to a blade-like end, without the distinct shoulder of the typical species; ædœagus stouter than in the other species.

Type and three paratypes male, from the Chanchamayo District, Peru, through Rosenberg, in collection of Cornell University; paratype female in U. S. National Museum, also from the Chanchamayo; both lots originally determined as *M. menophilus.* The species is also, as Mr. Rosenberg informs me, in the British Museum, from the Adams Collection.

EXPLANATION OF PLATES

PLATE II.

Male genitalia of *Melinaea egina,* with ædœagus figured separately.

Tips of valves of *M. comma,* showing also tips of dorsal processes. The dorsal processes are not visibly asymmetrical, but the one on the left is figured as if seen edgewise, the other in flat view.

Tips of valves and left dorsal process of *M. scylax*; typical of the remaining species of the genus.

PLATE III.

Diagrammatic representations of cell Cu_1 (cell 2) of fore wing of each species of Melinaea.

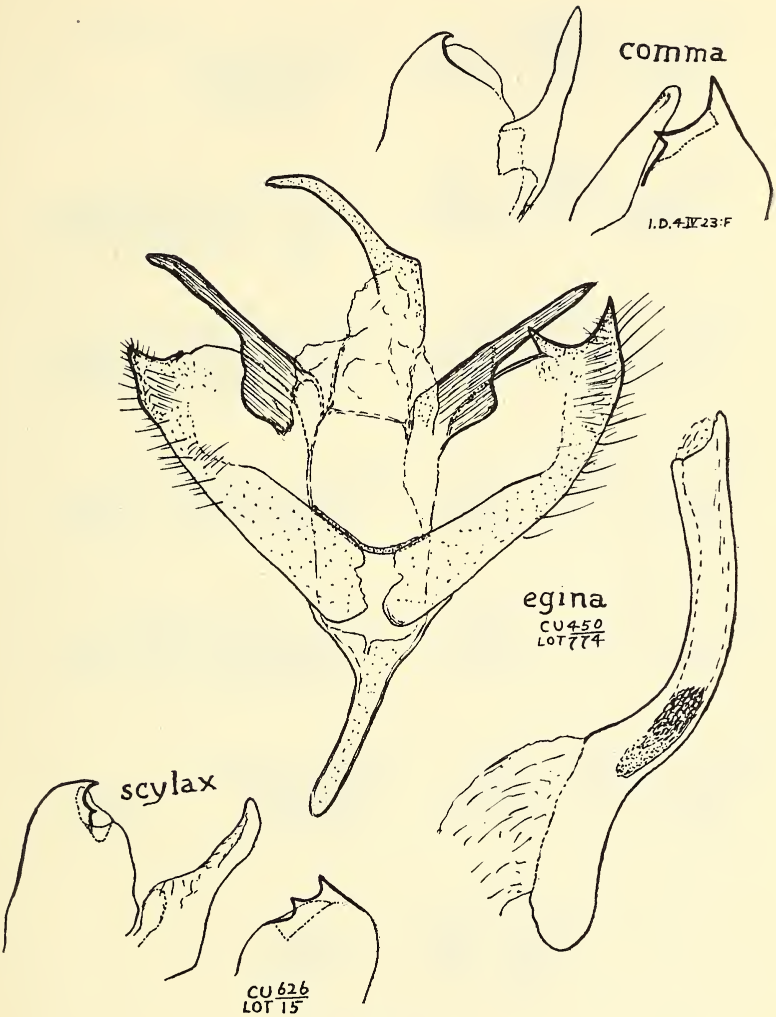
White areas represent white or yellow.

Dotted areas represent tawny or red-brown.

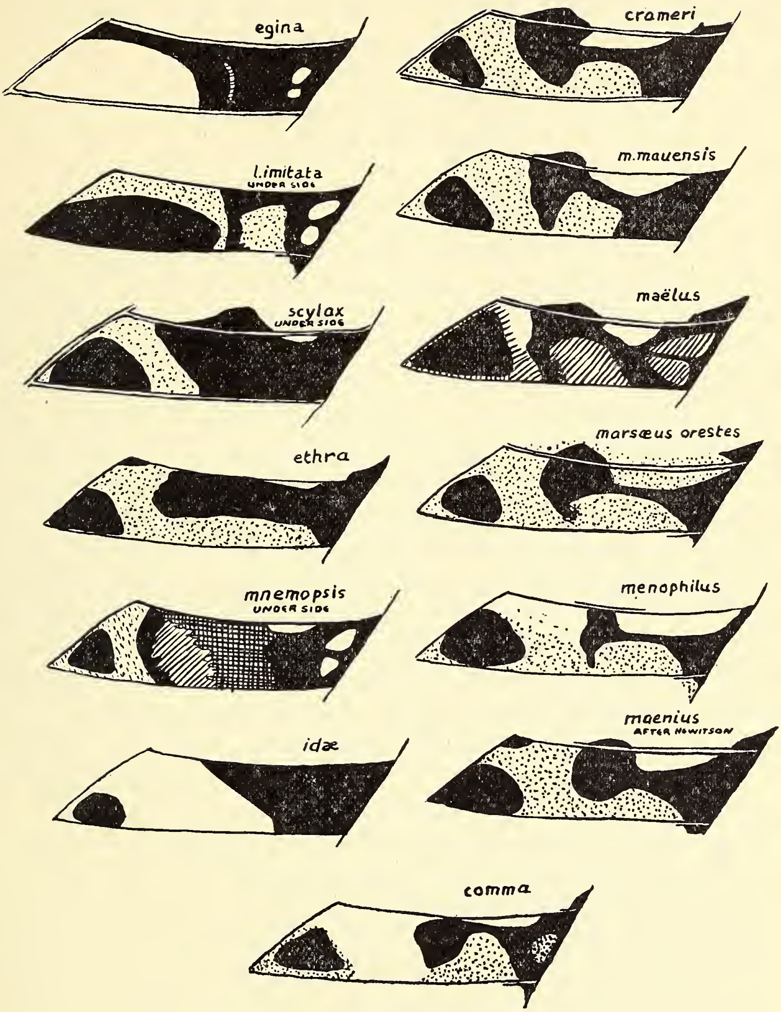
Striated areas represent deep brown.

Cross-hatched areas represent smoky.

Black represents black.



MELINAEA


egina
crameri
l.imitata
UNDER SIDE
m.mauensis
scylax
UNDER SIDE
maëlus
ethra
marsœus orestes
mnemopsis
UNDER SIDE
menophilus
idæ
maenius
AFTER HEWITSON
comma

MELINAEA

GRASSHOPPER CULTURE IN THE LABORATORY

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INTRODUCTION

During the winter relatively few insects are available in the laboratory for experimental purposes. Grasshoppers are not generally thought of as suitable for such use since they naturally hibernate during the cold months, and but one generation a year can be procured in most species. There are some forms, however, whose life cycles can be greatly shortened by temperature control so as to yield several generations a year. Furthermore, the application of various temperatures to the pods permits retarding or accelerating their development at will, so that if pods of one laying are divided into groups, each of which is kept at a different temperature, the nymphs can be made to emerge at predetermined intervals over a period of many weeks instead of at one time. This treatment, when applied to several sets, each laid a month or two after the one preceding, ensures a governed supply of living insects in any desired stage of development throughout the year. Such control of the life history has obvious value for experimental purposes.

Carothers ('23)[1] gives a brief account of breeding methods, mentioning a number of species requiring diverse treatments. The purpose of the present paper, therefore, is to describe the breeding technique more fully, in sufficient detail that those unaccustomed to handling such insects may rear them with minimum waste effort. Attention is confined to several forms that require the same treatment, are viable under laboratory conditions, and thrive on lettuce. Their eggs do not require a period

[1] E. Eleanor Carothers: "Notes on the Taxonomy, Development and Life History of Certain Acrididae (Orthoptera)," Transactions of the American Entomological Society, Vol. XLIX, March, 1923.

of freezing, and the length of the life cycle may be modified by subjecting the eggs to various temperatures, a simple device for which is described. Appreciation is expressed to Dr. Carothers for the many suggestions she made personally concerning breeding methods.

Bodine ('25)[2] gives a detailed analysis of the effects of temperature upon the development of eggs of various species of grasshoppers. He calls attention to the consequent advantages of the material for general experimental purposes. He divides the eggs into three classes: first, eggs that require a period of freezing to undergo development; second, eggs that are frozen naturally but can hatch without freezing; third, eggs that are not frozen naturally. Species that are best adapted for general experimental purposes are obviously those belonging to the second and third classes where hatching is not dependent upon freezing. Bodine ('25, p. 95) lists such forms as follows: *Melanoplus differentialis, Melanoplus femur = rubrum, Chortophaga viridifasciata, Chortophaga australior, Dichromorpha viridis, Arphia xanthoptera, Encoptolophus sordidus,* and *Romalea microptera.* The species reported in the present study are: *Chortophaga viridifasciata, Encoptolophus sordidus* and *Romalea microptera.*

Chortophaga viridifasciata[3] was bred in large numbers. It hibernates as a third-instar nymph. This period can be eliminated, making possible about six generations per year (Carothers, '23, p. 13). The time of egg development can be extensively shortened or lengthened by the use of various temperatures. It is unusually viable in the laboratory.

Encoptolophus sordidus was also reared but only in a very limited way. Its hibernation period in the egg state can be suppressed (Carothers, '23, p. 13) increasing the number of yearly generations. The time of egg hatching can be modified in a man-

[2] Joseph Hall Bodine: "I. Effects of Temperature on Rate of Embryonic Development of Certain Orthoptera," Journal of Experimental Zoology, Vol. 42, May, 1925.

[3] Descriptions of grasshoppers are given by W. S. Blatchley, "Orthoptera of North-Eastern America." The Nature Publishing Company, Indianapolis, 1920.

ner similar to that possible with *Chortophaga,* but the details were not worked out.

Romalea microptera (= *Rhomaleum micropterum*) was bred in quantity. Its life history is much longer than that of smaller species, hence it is not as adaptable as they are for general experimental purposes. It was not possible to secure more than one generation a year, but the time of egg hatching is subject to wide modification by temperature control. *Romalea* has a high death rate, but it is as easily cared for as the other species and can be reared successfully in the laboratory. Its very large size recommends it for some types of work.

CARE OF NYMPHS AND ADULTS

An insectary is the ideal breeding place, but if one is unavailable a south window is selected for maximum sun. A window receiving over six hours' sun in December may get less than three hours in the late spring when the sun is higher in the sky. The cracks between the sashes and the frame should be carefully packed with cotton to prevent the entrance of cold air.

A simple type of cage is illustrated (Plate IV) together with a device for roughly controlling the temperature of eggs. If cages are kept on shelves, the latter should be wide enough to allow some working space in front. Shelves must be far enough apart to allow a six-inch space above the tops of the cages when set upon their trough, so that cages can be watered from above or the glass fronts can be elevated without moving them.

When cages are used for nymphs the front glass is cut to accommodate a thin layer of dry sand (Plate IV, cage 1, G–H). The air should be dry. The damp atmosphere of a greenhouse is dangerous, since mould is a serious enemy of many species of grasshoppers in captivity. Those here reported are not usually affected, a factor greatly simplifying their care. Ventilation is another primary need of many grasshoppers. In the first generation in captivity most species die if brought indoors but live a considerable time in cages out-of-doors. Those reported here, however, thrive in the first generation under indoor conditions.

Lettuce is a satisfactory food for *Chortophaga, Encoptolophus,* and *Romalea,* as shown by the fact that successive genera-

tions properly mature their germ cells, mate and lay viable eggs. This is another factor simplifying their care. Dr. Carothers ('23, p. 10) mentions lettuce, but she also describes the use of wheat and other grasses grown in small pots. The latter require a great deal of time and trouble, since successive plantings are necessary as each crop keeps fresh for only about five days and then turns yellow and becomes harmful. Such foods are necessary for some species, but where lettuce can be used much time is saved. In summer *Chortophaga* can be fed various common grasses and clover, while *Romalea* eats dandelion. It is to be noted that nymphs do not eat for several days after hatching.

Lettuce of the solidly headed type is placed in the cages in quarter or half heads which keep fresh for four or five days. Lettuce that is loosely headed or single leaves dry out in a short time and are troublesome when handling small nymphs. When changing food, especially for early instars, the fresh material is placed beside the old, and the latter is not removed till the next day, after the insects have transferred themselves. When the glass is raised to change food but few escape as they go toward the light which is opposite the raised glass. Any that may get out are returned by the corked hole in the top of the cage (Plate IV) so that the glass need not be lifted again. Adults are picked up by the wings. Small nymphs must be carefully handled, by catching them in a small net and then picking them out with delicate forceps by the foreleg. If a hind leg is caught it is apt to be kicked off, or one of its joints may be harmed and cause trouble in later moults.

If *Chortophaga* is collected as a third-instar nymph in the fall, it will undergo a period of arrested growth for at least a month even though brought indoors. It requires the same food and care as at other times but it is sluggish and the absence of moulted skins indicates cessation of growth. This period which would have lasted through the winter in nature is greatly shortened in the first generation of captivity. It will not appear at all in later generations if the nymphs are kept unchilled.

Records of over seven hundred *Chortophaga* hatched show a mortality rate of about twenty per cent. during the growth period due chiefly to difficulty in one of the moults. There is a some-

what higher death rate in the first generation in captivity because of parasitism in some cases and unknown conditions in others. Although they eat moulted skins and dead bodies it is thought that there is little if any cannibalism. About fifty adults or a larger number of nymphs are kept in one cage 10″ x 11″ x 7″ as this species thrives despite considerable crowding.

Chortophaga requires about seven weeks to become adult when kept in a south window receiving four to five hours' sun a day, in a room with a temperature of 22° ± C. during the day, and 18° ± C. during the night. The first instar requires 10 ± days; the second, 7 ±; the third, 8 ±; the fourth, 11 ±, and the fifth, 13 ±.

Records were not kept concerning mortality and lengths of instars of *Encoptolophus,* but as in the case of many small grasshoppers, it requires about seven weeks to become adult.

Romalea has a high death rate. Of over five hundred individuals hatched, sixty-eight percent died, and but thirty-two percent reached maturity. As in the case of *Chortophaga,* the *Romalea* nymphs eat moulted skins and dead bodies, but in addition, there is much cannibalism. There were numerous instances, where larger ones were seen attacking smaller individuals that appeared perfectly healthy. Two factors encourage cannibalism: first, the mixing of nymphs in various stages of development, when the smaller ones always disappear; and second, over-crowding. An attempt was made to lessen cannibalism by supplying animal food, such as boiled egg, cheese, etc., but without success. Cannibalism is slight in the first and second instars, greatest in the third and fourth, but it does not occur among adults. About ten adults or twenty nymphs were kept in a cage 10″ x 11″ x 7″.

In an experiment now in progress to study the inheritance of body color in the cross, *Romalea microptera* var. *microptera* (yellow) × *Romalea microptera* var. *macri* (black), it has been found that the yellow form is considerably more viable than the black one.

Romalea requires about fifteen weeks to become adult when kept in a south window receiving four to five hours sun a day, in a room with a temperature of 22° ± C. during the day, and 18° ± C. during the night. The first instar requires 13 ± days;

the second, 18 ±; the third, 20 ±; the fourth, 23 ±, and the fifth, 31 ±.

By elevating the room temperature to an average of 25° ± C. both day and night, the nymphal period of *Romalea* was reduced to eight weeks instead of the fifteen-weeks' period required at a temperature of 22° ± C. during the day and 18° ± C. during the night. The nymphal period of *Chortophaga* was lengthened to ten weeks by lowering the temperature to an average of 18° ± C. during the day and 14° ± C. during the night, instead of the seven-weeks' period required at a temperature of 22° ± C. during the day and 18° ± C. during the night. Such rough observations indicate that the growth period can be considerably shortened or lengthened by modification of the temperature, giving control of this part of the life cycle for experimental purposes. Control of temperature would also probably affect the period of several weeks between the last moult and the time of mating and egg laying. If cages are enclosed to elevate temperature the question of ventilation will probably require attention.

CARE OF EGGS

When grasshoppers are ready to lay their pods, they are placed in a cage with the front glass cut to accommodate deep sand (Plate IV, cage 2, G′–H′). Sand is better than soil as it does not pack, and can be washed and sieved to eliminate impurities and larger particles. Its depth must be somewhat more than the elongated abdomen, which is extended during oviposition, or egg laying will be hindered. Two inches is sufficient for *Chortophaga* and *Encoptolophus* and three and a half inches for *Romalea*.

After egg laying has begun it is best to remove pods at weekly intervals. This facilitates the different treatment required by eggs in contrast to that necessary for nymphs and adults. It also gives a relatively accurate record as to when a given group of pods were laid, as there is possible a maximum variation of but a week. Adults are temporarily removed by placing an empty cage face to face with the one from which pods are to be taken. After the glasses have been withdrawn the grasshoppers pass over, since their positive phototropism is used as an aid in their transfer. A quick way of obtaining pods consists of sliding the

sand mass into a pail of tepid water since they float. The sand is gently stirred so that pods are not accidentally held at the bottom. Before placing them in a new cage its sand should be carefully sieved to eliminate stray single eggs that may have broken away from pods of former sets, as the hatching of such occasional eggs would interfere with the new hatching records. The pods should be placed in the sand in normal position at the depth in which they are naturally laid.

Sand containing pods must be kept moist (Bodine, '25, p. 92) or the pods dessicate and die. The sand is watered through the top netting with a rust-free container, care being taken not to dislodge the pods by the stream. When heat is applied to control the speed of egg development the sand must be watered frequently. Channels undetected by the eye may gradually be formed between surface depressions and the drainage holes so that the water passes off too quickly, wetting the surface to only a slight depth and leaving large regions of the deeper sand so dry that despite frequent surface wettings many of the pods dry out. If the top edge of the back glass (Plate IV, cage 2, E′–F′) as well as the top edge of the lower front glass (Plate IV, cage 2, G′–H′) are a little higher than the sand level, it can be well flooded, the water being held there between the glasses and slowly seeping down. If the sand is flush with the lower glasses, the water runs out through the back netting. When the sand is warmed the use of tepid water aids in maintaining a constant temperature. When nymphs appear, watering from above drenches them, hence remaining pods are watered by setting the cage for a short time in a vessel of water, the sand soaking it up through the drainage holes. Nymphs are not kept in a cage with unhatched pods since their droppings might affect the sand's acidity. Nymphs are also in less danger from mould if transferred to a dry cage.

The eggs of most grasshoppers, including those of *Chortophaga* and *Encoptolophus,* are pinkish, while those of *Romalea* are dark brown. The upper thicker cephalic end is marked by a small flat terminal region while the lower end is more slender and pointed. The top of the pod is marked by a mucus plug which fills up the hole after the abdomen has been withdrawn but this is easily

broken off. When a pod is in proper moist condition the individual eggs are easily separated from each other. This becomes more marked as egg development proceeds so that just before hatching the pod may fall apart if disturbed. On the other hand, in pods which have been allowed to dry out slightly, the individual eggs adhere closely to each other and cannot be separated without tearing the outer coats. A single egg in good condition is solid and firm and if pricked during early development the yellow yolk material squirts out, while one that has dried is less firm, having a thick and gummy contents. The development of embryos can be examined by cutting the eggs down the dorsal convex surface and floating the contents out in normal salt solution.

Since *Chortophaga* hibernates as a nymph it naturally passes through its egg phase quickly. Although *Encoptolophus* normally hibernates in the egg state, if the pods are kept warm the hibernation period can be eliminated. Since *Romalea* has a southern range its pods are not naturally subjected to freezing.

By controlling the temperature of the sand containing pods, the rate of egg development can be accelerated or retarded, so that pods of one laying can be made to emerge over a considerable period. The temperature of the sand and its contained pods in a given cage is roughly controlled by the wattage of the electric bulb in the trough underneath. This is further modified by slightly elevating the cage to a greater or less degree with narrow strips, thus permitting the escape of various amounts of heated air (Plate IV). Such means of regulating temperature are modified by other factors such as: the temperature of the room, which is usually about 22° C. during the day, and drops at night to about 18° C.; the sun's shining on the cage, which temporarily raises the sand's temperature 5° to 8° C. in winter, and considerably more in spring and summer; the fact that the temperature of the sand is affected by whether it is quite wet or somewhat dried out; the temperature of the water with which the sand is moistened, etc. A thermometer is inserted in the sand through the corked hole in the top of the cage.

It is obvious that the methods of controlling temperature here mentioned are crude, as the purpose was not to study the effect

of temperature upon development, but to control roughly the rate of development of various sets of pods in order to secure a continuous supply of living grasshoppers for experimental purposes.

Carothers notes ('23, p. 8) that under ordinary conditions sun is necessary for the emergence of nymphs. If the sand is heated, however, sun is unnecessary, and eggs develop normally, even though they have had no sun at all, and nymphs emerge without difficulty whether the sun is shining at that time or not.

If eggs are stored in unheated damp sand, in the shade, the evaporation keeps the temperature about 14° C., which permits only an exceedingly slow development of the embryos. If the cages are kept unheated but given normal daily sunshine, this intermittent heat accelerates development. Further speeding up is secured by the application of various amounts of continuous heat to the sand as described above. The pods may be laid in cold sand and stored in cold sand, to be placed later in the higher temperatures, a few at a time at various intervals; or they may be laid in warm sand and kept warm from the very beginning at higher temperatures. It is by different combinations of these methods that a given laying of pods can be made to emerge over a considerable period as desired. In applying such methods to grasshopper eggs generally, Bodine's ('25) observations must be kept in mind that certain species have definite rythms of susceptibility to low and high temperatures, and that there are wide differences in different species.

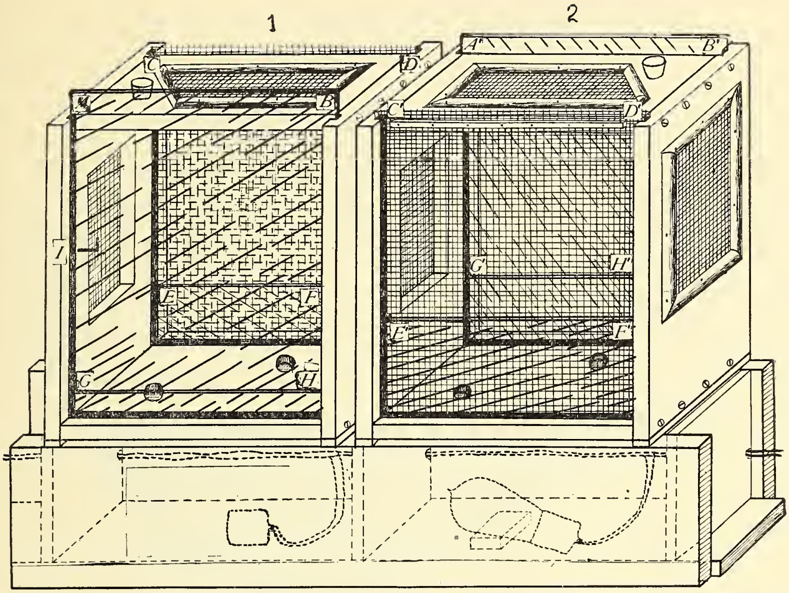
The shortest time for egg development of *Chortophaga* was four and one-half weeks at 34° ± C. Those which were laid in unheated sand, and within a week were transferred to sand kept at 25° C., hatched in about six weeks. This latter treatment was the one most commonly used. By keeping pods in cool sand for a shorter or longer period before applying heat, varying from 18° ± C. to 28° ± C., the period of development was lengthened to various points up to twelve weeks. It was not determined how long eggs can remain in cool sand and still remain alive, nor was refrigeration tried, but Carothers indicates ('23, p. 13) that at least this would be well over a year.

The effect of temperature upon the eggs of *Encoptolophus* was not studied in detail.

Romalea pods were laid during July and August in unheated sand and were allowed to remain there until mid October. They were then transferred, several at a time, at bi-weekly intervals, to sand heated at 25° ± C. Nymphs began emerging in late January and continued to hatch at intervals over a period of eighteen weeks. Whether or not an immediate application of heat would have produced an earlier emergence is not known.

PROPITIATION OF INSECTS

Frazer in "The Golden Bough" says that is the island of Oesel the Esthonian peasants "stand in great awe of the weevil, an insect which is exceedingly destructive to the grain. They give it a fine name, and if a child is about to kill a weevil they say, 'Don't do it; the more we hurt him, the more he hurts us.' If they find a weevil they bury it in the earth instead of killing it. Some even put the weevil under a stone in the field and offer corn to it. They think that thus it is appeased and does less harm." A German way of ridding a garden of caterpillars is for the mistress or another female member of the household to walk around the garden after sunset or at midnight, dragging after her a broom. "She may not look behind her, and must keep murmuring, 'Good evening, Mother Caterpillar, you shall come with your husband to church.' The garden gate is left open till the following morning."—Ed.



Cages and Device for Controlling Temperature of Eggs

The cages are shown in position on the trough for controlling the temperature of eggs. Cage 1 is seen in front view, with the front glass cut at G–H to accommodate a layer of shallow sand when used for rearing nymphs. Cage 2 is seen in back view, with the front glass cut at G′–H′ to accommodate deep sand when used for egg pods. When cages contain eggs, the sand is heated by electric lights placed in the compartments of the trough.

Cages for smaller species are 10″ wide x 11″ high x 7″ deep. They are made of cypress to prevent warping and are assembled with brass screws. The front (A–B and A′–B′) is of glass, sliding in a groove. The back (C–D and C′–D′) is of netting inserted in a similar groove, with an additional piece of glass, three inches high (E–F and E′–F′) across the lower portion, placed outside the netting. Sides and top have netted windows. All netting is of copper, 20 mesh to the inch, to prevent the escape of small nymphs. Drainage holes in the bottom have a piece of netting tacked over the outside and are filled with cotton to prevent the loss of sand. A half turn outward of the hook (I) holds the front glass up after it has been elevated.

A NEW FULGORID FROM PORTO RICO

BY H. L. DOZIER

DELAWARE AGRICULTURAL EXPERIMENT STATION

The Fulgorid here described is particularly interesting in that it is the second species to be described in the genus and also on account of its very interesting ecological habitat. *R. caudatum* was described by Van Duzee (Trans. San Diego Soc. Nat. Hist., 2, p. 43) as being abundant on wild sunflower at La Jolla, Cal. The genus *Rhyncopterix* is very close to *Colpoptera* and *Cyarda* and may have to be placed under the latter after further study.

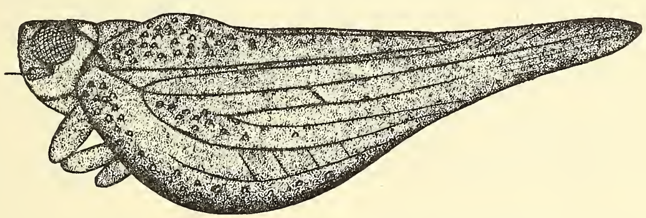


FIG. 1. *Rhyncopterix salina* Dozier (enlarged).

Rhyncopterix salina new species

Head short, distinctly shorter than that of *R. caudatum*. Vertex almost twice as wide as long, flat but with the disk very much depressed, carinate. Frons slightly longer than wide, sides narrowly foliaceous carinate, the disk towards apical end slightly longitudinally depressed. Pronotum distinctly longer than the vertex, carinate, produced anteriorly in obtusely rounded manner and extending to half the length of the eyes, posterior margin roundingly emarginate. Mesonotum twice as long as the pronotum, weakly tricarinate, the disk very much flattened and outlined by the lateral carinae which are sharply rounded anteriorly to meet the median carina before touching the pronotum. Elytra distinctly longer than broad, very much inflated and meeting below from near the middle to the apex; clavus very long, gibbous towards the base, distinctly granulate, especially for the basal half; commissural margin of clavus smooth and decidedly depressed; costa granulate, a few scattered granules towards base of longitudinal nerves.

General color varies from a testaceous brown to a darker fuscous, without any definite markings, the veins distinctly outlined by their darker color. The clypeus in many specimens with faint oblique lateral brown stripes.

Male genitalia: penis rather heavily chitinized, viewed laterally with anvil-like projections towards base in upper margin; apex produced with much curved spine-like processes at tips.

Described from a large series of specimens collected by the writer sweeping a pure stand of "Lirio de Mar," *Batis maritima,* near edge of salt lake in the extremely dry arid region west of Guanica, Porto Rico, February 12, 1925, and also a number

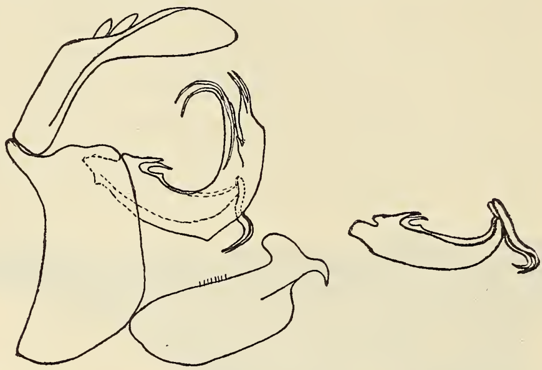


FIG. 2. Male genitalia of *Rhyncopterix salina* Dozier.

sweeping the shrub, *Lantana odorata,* on the nearby rocky slopes; two males in the collection of the American Museum of Natural History from Ponce, Porto Rico, July 20, 1914 (3716); a large series in the U. S. National Museum collected at Arroya, Porto Rico.

Holotype, female and allotype, male from Guanica, P. R., Feb. 12, 1925, deposited in U. S. National Museum (Cat. No. 40177).

RECORDS AND DESCRIPTIONS OF CRANE-FLIES FROM THE EASTERN UNITED STATES (TIPULIDAE, DIPTERA)[1]

By Charles P. Alexander

Amherst, Mass.

The new species described at this time were all included in the extensive collections of crane-flies submitted to the writer for examination by Professor J. Speed Rogers, to whom all types and uniques have been returned. In his preparation of the lists of Tipulidæ for the states of Iowa, Michigan, Indiana, Tennessee, North Carolina, Georgia and Florida, Professor Rogers has discovered a large number of previously undescribed species that are being discussed in a series of papers by the writer, whose sincere thanks are extended to the collector for the privilege of examining this rich material.

Dicranoptycha Osten Sacken

Dicranoptycha rogersi new species

Size large (wing over 10 mm.); general coloration light gray; legs brownish black; wings with a strong brownish gray tinge; costal fringe long and conspicuous in both sexes; male hypopygium with the outer dististyle relatively long and narrow, the outer margin serrulate.

Male.—Length about 10 mm.; wing 11.2 mm.

Female.—Length about 11 mm.; wing 12 mm.

Rostrum dark, sparsely pruinose; palpi brownish black. Antennae with the basal segment dark, sparsely pruinose; second segment light brown; flagellar segments dark brown, decreasing in diameter outwardly, the outer segments more elongated. Head gray.

Pronotum light gray. Lateral pretergites restrictedly pale. Mesonotal praescutum clear light gray, the usual stripes pale brown, narrow and indistinct, the intermediate pair narrowly separated, not reaching the suture; pseudosutural foveae elongate, black; humeral region very restrictedly pale; scutum dark gray, the scutellum and postnotum darker. Pleura light gray,

[1] Contribution from the Department of Entomology, Massachusetts Agricultural College, Amherst, Mass.

indistinctly variegated with darker longitudinal markings. Halteres pale, the knobs, except at tips, weakly infuscated. Legs with the coxæ gray; trochanters obscure yellow, darker at tips; femora brownish black, the extreme bases a little paler; tibiæ and basitarsi dark brown, their tips blackened; remainder of tarsi black. Wings with a strong brownish gray tinge, the costal and stigmal regions somewhat darker; veins dark brown; macrotrichiæ dark, the costal fringe relatively long and conspicuous. Venation: Sc_1 ending shortly beyond the fork of *Rs*, Sc_2 near its tip; *Rs* angulated and short-spurred at origin, approximately as long as or shorter than cell *1st* M_2; distal section of R_1 approximately as long as *m-cu*.

Abdomen dark brown, slightly pruinose, the hypopygium dark. Male hypopygium with the outer dististyle long and narrow, gradually tapering to the blackened tip, the outer margin of this apical spine weakly serrulate, the ventral or inner margin more nearly smooth; entire surface of style except the chitinized apex densely provided with a short erect pubescence. Aedeagus large.

Habitat.—Florida.

Holotype, ♂, Marion Co., April 13, 1926 (J. S. Rogers); Coll. No. 5. Allotopotype, ♀. Paratopotypes, 5 ♀♀.

Dicranoptycha rogersi is named in honor of my friend, Professor J. Speed Rogers, who has done invaluable work in determining the exact seasonal and geographical range of the North American Tipulidæ. The species is very distinct from the other ten species in Eastern North America.

Pseudolimnophila Alexander

Pseudolimnophila australina new species

Size small (wing, ♂, 4.5–5.5 mm.); mesonotal praescutum gray with four conspicuous brown stripes; pleura entirely dark colored, heavily pruinose; wings with a strong grayish tinge, the stigma darker; cell M_1 present.

Male.—Length 4–4.5 mm.; wing 4.5–5.5 mm.

Female.—Length about 6 mm.; wing 6–6.2 mm.

Rostrum and palpi black. Antennæ black, moderately elongated; flagellar segments (♂) gradually decreasing in diameter outwardly, elongate-oval to elongate-cylindrical, with conspicuous verticils; antennæ (♀) shorter. Head gray.

Mesonotal praescutum gray with four conspicuous brown stripes, the intermediate pair not reaching the suture; pseudosutural foveae shiny black; scutum brownish gray, the centers of the lobes darker; postnotum dark gray. Pleura uniformly darkened, gray pruinose. Halteres pale, the knobs dark brown. Legs with the coxæ yellowish testaceous, their bases

infuscated; trochanters obscure yellow; femora obscure yellow, soon passing through brown or dark brown to brownish black; tibiæ and tarsi brown to brownish black. Wings with a strong grayish tinge, the oval stigma slightly darker brown; veins still darker brown. Venation: Sc_1 ending just before *r-m*, Sc_2 at its tip; *Rs* nearly straight to gently arcuated at origin; *r* about one and one-half times its length beyond the fork of R_{2+3}; *m-cu* at about one-third its length beyond the fork of *M*; anterior arculus preserved.

Abdomen dark brown, this color usually including the hypopygium, in some cases the latter a little paler. Ovipositor with the tergal valves elongate, upcurved.

Habitat.—Southeastern United States.

Holotype, ♂, Marion Co., April 4, 1926 (J. S. Rogers); Coll. No. 1. Allotopotype, ♀. Paratopotypes, ♂ ♀'s; paratype, ♂, Beltsville, Maryland, July 9, 1916 (W. L. McAtee).

The writer (Crane-flies of New York, Part I; Cornell Univ. Agr. Expt. Sta. Mem. 25: 917; 1919) had considered the present species to represent *P. contempta* (Osten Sacken). An examination of Osten Sacken's type of *contempta,* however, shows that it pertains to the larger northern species that was later described by Alexander and Leonard as *P. nigripleura.* The dark pleural stripe is still perfectly evident on the type of *contempta. P. nigripleura* therefore must be placed in the synonymy of *contempta,* leaving the southern species to be re-named as above.

Gonomyia Meigen

Some notable additions to our knowledge of the distribution of the Nearctic species of *Gonomyia* have been made in recent years. The then known facts in the distribution of the genus were indicated in a paper by the writer (Proc. Acad. Nat. Sci. Philadelphia, 1916: 508–528; 1916).

The *cognatella* group

The chief characters for the separation of the species in this group lie in the details of structure of the male hypopygium, especially the shape of the dististyles and gonapophyses. The outer dististyle, especially, offers excellent characters. In the more specialized species (*cognatella*) this is a very elongate sinu-

ous rod, that is somewhat shorter and more powerfully constructed in others (*florens, armigera*). The style is shortest, less than one-half the length of the longest arm of the inner dististyle in the two new species described hereinafter. The inner dististyle is profoundly split into an elongate spine-tipped arm, a shorter pale arm that terminates in a few setiferous tubercles, and a very short finger-like lobe. In the review of the Nearctic Gonomyiæ, above cited, the spinous arm of this style was considered as being the third appendage, the setigerous arm the first or dorsal appendage (d). In the various species, the spinous arm is constricted and bent strongly upon itself a short distance beyond the base, appearing as an elongate, simple, more or less sinuous rod, bifid in *kansensis*. The gonapophyses bear acute lateral or subapical spines on the margin, in *kansensis* both spines occurring, the smaller lateral spine being directed caudad toward a larger subapical spine, the two enclosing an oval notch. The subapical spines are more slender and directed strongly cephalad (*cognatella, taeniata*) or dorsad into powerful chitinized spikes (*florens, armigera*). The lateral spine is generally lacking but in *reflexa* is conspicuously developed.

Gonomyia (Gonomyia) cognatella (Osten Sacken).

IOWA: Powesshiek Co.; Rogers No. 52.

Gonomyia (Gonomyia) florens Alexander.

This species had been considered as being a northern form but what certainly appears to be the same has been taken as far south as the Upper Austral Region.

ILLINOIS: Anna, Union Co., June 13, 1922 (C. P. Alexander).

INDIANA: Hensler's Woods, near Hanover, Jefferson Co., June 16, 1921 (Alexander and Rogers).

Gonomyia (Gonomyia) armigera Alexander.

Described from Corydon, Harrison Co., Indiana.

INDIANA: Jefferson Co., July 22, 1921 (J. S. Rogers); No. 64.

Gonomyia (Gonomyia) spinifer Alexander.

TEXAS: Old Fort Davis, Davis Mts., Jeff Davis Co., altitude 5,000 feet, November 15, 1925 (O. C. Poling). Numerous specimens in the Rogers Collection.

Gonomyia (Gonomyia) kansensis Alexander.

A prairie species, originally described from Kansas.

ILLINOIS: Muncie, Vermillion Co., June 10, 1919 (Alexander).

INDIANA: Hensler's Woods, near Hanover, Jefferson Co., June 16, 1921 (Alexander and Rogers).

Gonomyia (Gonomyia) taeniata new species

Male.—Length about 4–4.2 mm.; wing 4.5–4.8 mm.

Belongs to the *cognatella* group, from the allied members of which it is distinguished by the structure of the male hypopygium.

Rostrum and palpi black. Antennæ with the scape and basal two segments of flagellum yellow; flagellar segments relatively elongate, densely clothed with a pale erect pubescence. Head yellow with a conspicuous dark brown spot on the vertex.

Mesonotal praescutum grayish brown, the humeral region and broad lateral margins buffy; scutum obscure yellow, the centers of the lobes brown; median area of scutum and the scutellum with a narrow brown line; postnotal mediotergite yellow with a dark brown basal triangle. Pleura with a silvery longitudinal stripe broad and conspicuous, narrowly margined above and below by a narrow darker line; dorsal pleural region dusky brown; sternopleurite pale, pruinose. Wings with a strong brownish yellow tinge, the ill-defined stigma darker; veins still darker brown. Venation: Sc_1 ending opposite the origin of Rs, Sc_2 close to or somewhat removed from its tip; veins R_2 and R_3 rather strongly divergent; cell *2nd* M_2 about twice as deep as its petiole.

Male hypopygium with the outer dististyle small, pale, sinuous, approximately one-half the length of the longest arm of the inner dististyle, gradually narrowed to the slender tip, the margin of the style with about five setæ, arranged along its length. Spinous arm of the inner dististyle very long and ribbon-like, at apex narrowed into a small black spine; setigerous arm of inner dististyle approximately as long as the outer dististyle, with numerous setæ along its stem, the terminal tubercles scattered. Gonapophyses compressed, the subapical spines very conspicuous, directed strongly cephalad; no lateral spines present.

Habitat.—Southeastern United States.

Holotype, ♂, six miles south of Tifton, Tift Co., Georgia, June 1, 1923 (J. S. Rogers); Coll. No. 1. Paratopotypes, 2 ♂♂, 1 ♀, with the type; paratype, ♂, Haywood Co., North Carolina, August 3, 1924 (J. S. Rogers); Coll. No. 31.

Gonomyia (Gonomyia) reflexa new species

Male.—Length about 4 mm.; wing 4.6–5.2 mm.

Female.—Length about 5 mm.; wing about 5 mm.

Belongs to the *cognatella* group, from the allied members of which it is distinguished especially by the structure of the male hypopygium.

Rostrum and palpi dark brownish black. Antennæ with the basal segments yellow, the elongate outer segments brownish black. Head yellow, the center of the vertex with a dark brown spot.

Mesonotal praescutum brown, without stripes, the scutellum somewhat brighter colored; postnotal mediotergite pale, with a darker triangle at base, the surface pruinose. Pleura with the ventral silvery stripe broad. Wings with a strong yellowish tinge, the oval stigma darker, relatively ill-delimited; veins darker. Venation: Sc_1 ending opposite the origin of *Rs*, Sc_2 shortly removed from its tip, Sc_1 about one-half *m-cu; m-cu* at the fork of *M*.

Abdominal tergites dark brown, the caudal margins of the segments conspicuously light yellow. Male hypopygium with the outer dististyle a short, powerful chitinized rod, the stem very gently curved, at apex expanded and directed at right angles into a long straight point, the whole apex suggesting the head and beak of a bird; the disk of the head-like portion is provided with numerous setae; region of the crest with a simple or weakly bifid spine; outer style less than one-half the length of the longest (spinous) arm of the inner dististyle. Spinous arm of the inner dististyle broadest at base, narrowed very gradually to the acute blackened apex; setigerous arm of style slender, the tubercles at tip separated. Gonapophyses appearing as large compressed blades, the ventral margin with a curved lateral spine that is directed caudad; no subapical spine. Aedeagus broadly dilated near midlength.

Habitat.—Michigan.

Holotype, ♂, Warren Woods, E. K. Warren Preserve, Berrion Co., July 17, 1920 (J. S. Rogers); Coll. No. 169. Allotopotype, ♀, with the type; Coll. No. 68. Paratopotypes, 6 ♂ ♀, July 4–17, 1920 (J. S. Rogers).

Gonomyia (Gonomyia) bidentata Alexander.

The known range of this species has been greatly extended as a result of the last few years collecting:

WISCONSIN: Cascade Falls, Osceola, Polk Co., July 13, 1925 (G. C. Crampton).

INDIANA: Clifty Ravine, Jefferson Co., June 15, 1921 (Alexander and Rogers); type-locality.

NEW YORK: Ausable Chasm, August 15, 1925 (G. C. Crampton); Sacandaga Park, Fulton Co., August 28, 1925 (Alexander); Masten's Woods, Gloversville, August 31, 1925 (Alexander).

VERMONT: Halifax Gorge, Windham Co., August 23–September 6, 1925 (Alexander and Crampton).

MASSACHUSETTS: Mt. Toby, Franklin Co., July 10, 1923–July 28, 1925 (Alexander); Orient Springs, Hampshire Co., July 24, 1925 (Alexander).

MAINE: Mt. Desert, common in arbor-vitae swamps on western half of island, August 29–September 12, 1926 (C. P. and M. M. Alexander).

The species is characteristic of gorges, ravines and cool northern woods, from mid-July into September.

Gonomyia (Lipophleps) cinerea (Doane).

TEXAS: Old Fort Davis, Davis Mts., Jeff Davis Co., altitude 5,000 feet, November 15, 1925 (O. C. Poling); at light.

Gonomyia (Lipophleps) helophila Alexander.

TEXAS: As in the last species, November 11–15, 1925. This is a widely distributed Neotropical species which probably reaches its northern limit at about this latitude.

ORMOSIA RONDANI

Ormosia brevicalcarata new species

Allied to *adirondacensis* Alexander; mesonotum reddish brown, the praescutum with a darker median line; wings subhyaline, the stigmal region darker; vein *2nd A* slightly sinuous; male hypopygium with the projection on the margin of the inner dististyle very small; aedeagus relatively short, blackened.

Male.—Length about 3.4 mm.; wing 3.3 mm.

Female.—Length about 4 mm.; wing 4.3 mm.

Rostrum and palpi dark brown. Antennae (♂) of moderate length, if bent backward extending about to the wing-root; antennae brown, the basal segments somewhat paler; flagellar segments with a dense erect white pubescence, in addition to the usual verticils. Head dark.

Thorax reddish brown, the median region of the praescutum darker; tuberculate pits placed in the darkened area; postnotum slightly infuscated. Pleura pale reddish, with a vague gray area on the anepisternum and the meron. Halteres pale, the knobs a little infuscated. Legs with the coxæ and trochanters obscure yellow; remainder of legs brown, densely covered with black setæ, the femoral bases narrowly paler. Wings subhyaline, the stigmal region darker; veins dark brown. Venation: *r* about its own length beyond the fork of R_{2+3}; cell *1st* M_2 open by the atrophy of the outer deflection of M_3; *m–cu* at the fork of *M*; vein *2nd* A with the

distal third or less sinuous, more so than in *adirondacensis*, the vein more nearly straight in the female.

Abdomen dark brown, the hypopygium paler. Male hypopygium much as in *adirondacensis* but the thumb-like projection on the margin of the inner dististyle is here reduced to a small triangular point, the region resembling the head of a short-beaked bird. Aedeagus relatively short, heavily blackened, the tip not expanded.

Habitat.—North Carolina.

Holotype, ♂, Crestmont, Haywood Co., altitude 1,700 feet, July 29, 1924 (J. S. Rogers); Coll. No. 17. Allotopotype, ♀. The allotype has been returned to Professor Rogers.

CRYPTOLABIS OSTEN SACKEN

Cryptolabis (Cryptolabis) minutula new species

Size very small (wing, ♂, 3.5–4 mm.); general coloration gray, the lateral pretergites dirty whitish; pleura indistinctly variegated with paler; wings subhyaline; macrotrichiae of apical cells very sparse, appearing as a line near mid-width of the cells; *Sc* short, *Rs* strongly convex; male hypopygium with the apex of the dististyle narrow, obtusely rounded.

Male.—Length 2.5 mm.; wing 3.5–4 mm.

Female.—Length about 3 mm.; wing about 4–4.2 mm.

Head and palpi brownish black. Antennæ brownish black throughout; flagellar segments oval, the segments decreasing in length and diameter outwardly. Head dark brownish gray.

Pronotum dark brownish gray. Lateral pretergites dirty whitish. Mesonotum gray, the praescutum with a broad brownish median stripe; median region of scutum more reddish brown; median region of scutellum and the anterior lateral angles of the postnotal mediotergite paler. Pleura brownish gray, variegated with paler on the sternopleurite and on the cephalic portions of the pleurotergite. Halteres pale, the knobs darker. Legs with the coxæ and trochanters pale; femora and tibiæ brown, their tips slightly darker; tarsi passing into dark brown. Wings subhyaline, the base narrowly more whitish; stigmal region barely clouded; veins dark brown. Macrotrichiae of cells of wing sparse, virtually restricted to a single line along the center of the cell. Venation: *Sc* relatively short, Sc_1 ending shortly before or opposite midlength of *Rs*, Sc_2 far from its tip, the portion of Sc_1 before the origin of *Rs* approximately twice as long as that section beyond this origin; *Rs* short, very strongly convex; basal section of M_{1+2} short; *m–cu* perpendicular to Cu_1.

Abdomen brown, the genital segment paler. Male hypopygium with the dististyle slender, gradually narrowed to the slender, obtusely rounded apex, the surface of the style with spare scattered setæ.

Habitat.—Texas.

Holotype, ♂, Old Fort Davis, Davis Mts., Jeff Davis Co., altitude 5,000 feet, at light, November 15, 1925 (O. C. Poling). Allotopotype, ♀. Paratopotypes, several ♂ ♀ in the Rogers Collection.

Cryptolabis minutula is one of the interesting crane-flies discovered in the Davis Mountains, Texas, by Mr. Poling. It is most closely allied to *C. bisinuata* Doane, of the northwestern United States, differing in the smaller size and details of coloration and venation. The dististyle of the male hypopygium of *C. paradoxa* Osten Sacken is acutely pointed at apex, as correctly shown by Osten Sacken (Mon. Dipt. N. Am. 4: pl. 3, fig. 13; 1869).

RECORDS OF FUNGOUS BEETLES IN FLORIDA

The following records, except in one instance as noted, refer to captures made at Gainesville, Florida, during 1925 and 1926. I am indebted to Mr. F. M. Schott and to Mr. Chas. Schaeffer for the identifications. *Cherostus fulvomaculata* Dury bred from *Polyporus lucidus,* July and on *Lepiota procera* in June; *Ennearthron thoracicorne* Ziegl., feeding in *Dadaelia ambigua,* March 8; *Hoplocephala viridipennis* Fab., feeding on *Dadaelia ambigua,* November 17; *Euparius marmoreus* Oliv., on *Polyporus gilvus,* November 21 (A. N. Tissot) ; *Hoplocephala ferruginea* Lec., in *Polyporus lucidus,* November 13; *Ennearthron thoracicorne* Ziegl., and *Cis creberrima* Mellie in *Polyporus versicolor,* February; *Hoplocephala viridipennis* Fab., on *Polyporus versicolor,* February 26; *Platydema ellipticum* Fab., bred from *Polyporus gilvus, Alachua,* Florida, July.—ERDMAN WEST.

BOOK NOTICES

The Natural History of Ants. By René Antoine Ferchault de Réaumur. Translated with an introduction and notes by William Morton Wheeler. Knopf, New York. $5.00.

One does not have to be a myrmecologist or even an entomologist to enjoy Professor Wheeler's translation of Réaumur's hitherto unpublished mémoire on ants, or his account of Réaumur's life and associates. One learns of Réaumur's research work—which was not by any means confined to entomology, but embraced mathematics, physics, metallurgy, meteorology, etc., and resulted in contributions of extreme value—of his interest in animal behavior, of his views on classification, which will seem outrageous to many present-day systematists, of his interesting quarrel with Buffon—now that scientists no longer quarrel publicly, at least hardly ever—of his influence on his contemporaries and successors and of many other things about this distinguished and versatile naturalist. And then there is the author's adequately translated and delightful mémoire on ants together with Professor Wheeler's numerous and enlightening annotations. Professor Wheeler comments upon the absence of historical mindedness among entomologists, which is a fact, but I hope they will not persist in carrying this state of mind so far as to fail to read this book.—H. B. WEISS.

Insects and Greek Poetry. By Lafcadio Hearn. The Rudge Press, New York, 1926. $3.00.

A lecture delivered by Lafcadio Hearn before his Japanese class in English literature and reprinted in book form for the first time. A slim bibelot, as pleasing to look upon and to handle as it is to read.—H. B. W.

NOTES ON SOME AMERICAN DRAGONFLY NYMPHS (ODONATA, ANISOPTERA)

BY C. FRANCIS BYERS
CORNELL UNIVERSITY

Dr. James G. Needham has amassed at Cornell University an excellent collection of American Odonata nymphs. It has been the writer's privilege to work over this material in preparation for its inclusion in his forthcoming "Handbook of the Odonata of North America." Many interesting points on the taxonomy of the immature dragonflies came to light during this work, the more important of which have been incorporated in the following notes.

ANAX LEACH

The genus Anax is well represented in American collections, in both the adult and immature forms, by the "Common Green Darner," *Anax junius.* This dragonfly has a wide distribution, being found in North and South America, Hawaiian Islands and on the west coast of Asia. Three other species of this genus are found in the New World. *Anax longipes,* with its race *concolor,* ranges from Massachusetts, Ohio, and Indiana, to Florida, Jamaica and Mexico. *Anax walsinghami,* "The Great Green Darner," the largest North American dragonfly, measuring 112 mm. total length, with a fore wing expansion of 124 mm., is restricted to California, Arizona, Lower California and Guatemala. The tropical *Anax amazili* ranges from Mexico and Central America to Brazil, Cuba and the Barbados, and has not hitherto been recorded from the United States.

The nymphs of Anax, while more or less known, are incompletely described and the records are in a chaotic condition. Louis Cabot (1881) described the first American Anax nymphs when he described *A. junius, A. amazili,* and mentioned *A. walsinghami* (Syn. *Aeschna validus*) and *A. longipes* in his mono-

graph of the immature stages of the Odonata. Dr. Needham (1904) described what he took to be *A. longipes*. *A. walsinghami* while known has never had a formal description.

The Needham collection yielded a large number of the nymphs of *A. junius,* one female specimen of *A. walsinghami,* and two males of *A. amazili.* No nymphs of *A. longipes* were obtainable.

Anax junius Drury

(FIGS. 3 AND 4)

The descriptions of *Anax junius* as given by Cabot (1881) and Needham (1901) are sufficient and need not be repeated here. The descriptions were made from reared material. The following are the distinguishing points. The "lateral lobes suddenly rounded off at end to incurved internal hook, not truncate." "Basal projection of the middle appendage of the male, half as long as lateral appendages." The mentum is 2 mm. wide at the base and 9 mm. long. There are no teeth on the distal border of the mentum. Length 40–52 mm.

Anax longipes Hagen

The writer has never seen the nymph of this species. Therefore, he is forced to take Needham's description in place of a specimen. The nymph is considered identical with *A. junius* except in the cases where Needham specifies otherwise. Length 55 mm.

Anax walsinghami McLachlan

(FIGS. 1, 5, 7)

Material: 1 full grown female from San Diego, California, dated "Aug. 15."

Description: Total length 58 mm. Length of abdomen 45 mm. Width of abdomen 11 mm. Width of head 10 mm. Length of hind femora 10 mm. Labium long and comparatively slender (Fig. 1). Base of mentum 4 mm. wide, length of mentum 12 mm., apical third little expanded over the proximal two-thirds, sides comparatively straight. Median cleft deep (.75 mm.). The

distal margin of the mentum with a deep fringe of hairs, in which, on either side and a little removed from the margin of the median cleft, are two small spines (Fig. 5). Lateral lobes squarely truncate, though somewhat rounded on the outer angle by a crescent-shaped piece of chitin. Lower angle ending in a strong tooth. Movable hook with a row of very fine nearly invisible setae (Fig. 7). Abdominal appendages: inferiors 7 mm., superiors 5.5 mm., laterals 4 mm. Lateral spines on segments 7, 8 and 9 well developed and sharp. Female genitalia 1 mm. removed from posterior border of 9. Coloration as in *Anax junius.*

Identity of species: I have assigned this nymph to *Anax walsinghami* because of its large size; 58 mm. in length. Obvious differences from *A. junius* and *A. amazili* makes confusion with these forms unlikely (see key). It is not *A. longipes* if Needham's (1904) description of that species holds good. Also, the wing venation as seen through the wing pads is very distinct and agrees better with *A. walsinghami* than any other Anax. The place of its collection (California), though frail evidence, favors reference to this species.

Anax amazili Burmeister

(FIGS. 2, 6, 8)

Material: 2 males from Panzardi, Hato-rey, near San Juan, Porto Rico. Collected by Mr. Julio Garcia, September 15, 1926.

Description: Length 53 mm. Length of abdomen 39 mm. Width of abdomen 10 mm. Width of head 9 mm. Length of hind femora 9 mm. Labium comparatively shorter and broader (Fig. 2). Mentum 3 mm. wide at base and 10 mm. long. Apical third of mentum expanded more than basal two-thirds. Median cleft .50 mm. deep. Fringe of hair on the distal margin of the mentum heavy but short. A stout black tooth on either edge of the median cleft (Fig. 6). Lateral lobes squarely truncate. Superior angle square, chitinized; inferior angle with the usual heavy tooth. The movable hooks bear superiorly a row of heavy dark setae (Fig. 8). Basal projection of the superior appendage of the male one-third as long as the inferiors. Lateral spines on segments 7, 8, 9, and coloration as in *A. junius.*

Identity of Species: While no reared material is at hand I have no hesitancy in assigning the above nymphs to *A. amazili.* They agree with Cabot's inadequate description of this species. One of the two nymphs would have emerged in a very short time, so the adult wing venation is easily visible through the pads. A more convincing point, however, is arrived at when the head is partially cleared in carbol-xylol. After this treatment, two dark lateral triangles and a light triangular spot can be readily seen on the frons. The geographical location, coloration and structural characters and elimination (see key) all favor reference to *A. amazili.*

Remarks: In Cabot's (1881) account of the nymphs of Anax he fails to mention the prominent black teeth on the mentum of *amazili.* However, under his description of *A. junius* he says, "Several specimens from San Diego, California, differ in having *black teeth* in the middle of the comb of the front border of the mask." He thinks that this may be the nymph of *A. walsinghami,* but goes on to say, "Nevertheless, it seems doubtful that nymphs very similar to *Anax junius* should belong to the gigantic and very different *A(eschna) validus* (*Anax walsinghami*). In view of the specimens on hand it is possible that Cabot's smaller *junius*-like nymph with the black teeth (Fig. 6) on the mentum is *A. amazili,* and that Cabot never saw the larger *A. walsinghami* with its two spines (Fig. 5) on the mentum instead of teeth. The geographical location (California) recorded by Cabot for this nymph is against this idea, for it would be by far the northernmost record for *amazili* and the only one from the United States.

The following key will separate the New World nymphs of the genus Anax as I conceive them to be:

KEY TO ANAX NYMPHS

1. Lateral lobes of the labium tapering to a hooked point. Basal projections of the superior appendage of the male half as long as the inferiors. No teeth on the mentum on either side of the median cleft .... (2)

   Lateral lobes of the labium squarely truncate, a little rounded on the superior angle. Small teeth on the mentum on either side of the median cleft .... (3)

2. Lateral abdominal appendages half as long as the superiors. Superior margin of the superior abdominal appendage very convex............*longipes?*
   Lateral appendages less than half as long as the superior. Superior margin of the superior abdominal appendage not extremely convex. A common species..............................*junius.*
3. Movable hooks with a row of heavy dark setæ. Teeth on either side of the median cleft stout and black, located on the very brink of the cleft, well exposed. Basal projection of the superior abdominal appendage of the male one-third as long as the inferiors........................*amazili.*
   Movable hooks with a row of very fine almost invisible setæ. The teeth on either side of the median cleft small and thin, removed a little distance from the edge of the cleft, hidden among heavy hairs.................. .... *walsinghami.*

AESHNA FABRICIUS

Since the publication of Dr. E. M. Walker's (1912) monograph of "The North American Dragonflies of the Genus Aeshna," little has been done on this group. Dr. C. H. Kennedy described two new species—*A. arida* (1918), *A. walkeri* and its nymph, and the nymph of *A. interrupta nevadensis* (1915); Dr. Walker (1921) described the nymph of *A. sitchensis.* The following nymphs are as yet unknown: *A. cerulea septentrionalis, A. interrupta interna, A. ventricalis, A. mutata,* and *A. arida.* The Needham collection contains a reared specimen and cast skin of *A. tuberculifera*; the description of this specimen follows:

Aeshna tuberculifera Walker[1]

(FIG. 9)

Material: 1 reared male and cast skin bearing the label, "Pond between Harrisville and Natural Bridge in Lewis County, N. Y., July 4, 1923."

Description: Length 45 mm. Abdomen 32.5 mm. Width of abdomen 8 mm. Width of head 8.25 mm. Length of hind femora 7 mm. Hind wing pad 10 mm. Labium long, 10 mm. from tip to

[1] *Aeschna tuberculifera* was originally described by Dr. E. M. Walker (1914), and figured by R. H. Howe (Manual of Odonata of New England). It has been redescribed here because of the difference in my specimen from the ones previously described and to separate it from *A. umbrosa,* its nearest relative.

hinge. Mentum strongly narrowed in proximal half but expanded in the distal half, the width at the base (2 mm.) being less than half that at the apex (5 mm.). Length of mentum 7.5 mm. A small tubercle at either side of the median cleft. Setae on movable hook few but comparatively long. Lateral lobes squarely truncate, inner angle ending in a small hook. Eyes prominent, the antero-posterior diameter a little longer than the transverse diameter. Lateral margins of the head straight. Posterior-lateral angles of the head prominent but well rounded. Hind margin nearly straight.

Supracoxal processes well developed, conical, the posterior lobe slightly the larger.

Abdomen slender, widest at segment 6. Lateral spines on segments 6, 7, 8, 9, those on 6 rudimentary. Abdominal appendages, inferiors 4.5 mm., laterals 2.5 mm.; superior 4 mm. Apices of laterals very slender and fine-pointed.

Coloring as in *Aeshna umbrosa.* The annuli on the legs are very pale in my specimen though easily distinguishable. Also the median pale band is hardly distinguishable from the lateral brown ones. The median spots are prominent and are distinctly bilobed on segments 7 and 8. The lateral scars are obscure.

Remarks: A. tuberculifera is remarkably like *A. umbrosa,* to which it would run in Walker's (1912) key. The principal differences between the two species are to be found in the labium (Figs. 9 and 10). The mentum is longer in proportion to its width in *A. tuberculifera* (2 mm.: 7.5 mm. in *A. tuberculifera*; 2 mm.: 6.5 mm. in *A. umbrosa*). The setae on the movable hooks are longer in *A. tuberculifera. A. umbrosa* lacks the small tubercles on either side of the median cleft, found in *tuberculifera.* The antero-posterior diameter of the eyes is greater than the transverse in *A. tuberculifera,* the same in *umbrosa,* and the inferior appendages tend to be shorter. In my specimen the annuli on the legs are more obscure than in *umbrosa.* However, they are present on both tibia and femora.

Sympetrum Newman

Dr. E. M. Walker (1917) published an account of the nymphs of the genus Sympetrum, to which I have little to add. One cor-

rection should be noted on page 409. *S. madidum* is listed among the undescribed species. Needham (1904) published a description of a nymph he supposed to be that species. The North American nymphs of Sympetrum remaining undescribed are *S. ambiguum* (syn. *S. albifrons*), *S. atripes* and *S. verum*.

Sympetrum pallipes Hagen

(FIG. 11)

Walker (1917) described this nymph and figured the labium. In the Cornell collection there turned up a reared nymph of *pallipes* differing greatly and in a peculiar manner from the one described by Walker. This specimen was reared by Dr. Needham at Dry Lake, Utah, July 22, 1926. The adult is a teneral male, with hamuli and superior appendages almost identical with those of *S. obtrusum.* However, although teneral, its color seems distinct enough to separate it from the above-named species. The black band before the eyes and the black tibia and tarsus of the *obtrusum* group are lacking in this specimen; and as the hamuli readily separate it from *S. ambiguum, S. pallipes* is the only reasonable identification.

This nymph agrees well enough with Walker's description except that the dorsal hook on segment nine is lacking and the distal margin of the mentum in outline is dome-shaped instead of conical as in the one figured by Walker for *S. pallipes.* The modification (Fig. 11) is very distinct and segregates this nymph from all other Sympetra at a glance, yet there is nothing peculiar about the adult. This is a curiosity that I can not explain.

Sympetrum illotum Hagen

While known and figured this species has never been formally described. The following description is from an unpublished manuscript written by Dr. James G. Needham:

"I have twice published figures of the nymph of this species without description (Out-door Studies, figs. 68, 69, 70, on pp. 66 and 67, and Bull. N. Y. State Museum No. 47, plate 25, fig. 1). In 1897 Mr. R. W. Doane sent me specimens from California, and two years later Professor Kellogg sent me reared specimens

from the Stanford University Collection (Lot 143, Sub. 28). In describing the closely related *S. corruptum* in Bull. 68, N. Y. State Museum, p. 271, I compared the nymph of that species with this one in some characters, but I will here give a fuller description.

Length 18 mm., abdomen 10 mm., hind femur 5 mm., width of head 5 mm., of abdomen 6.5 mm.

Body rather smooth except on the margins which are thinly hairy, slightly depressed, stout. Head wider than long with eyes directed antero-laterally, and rather prominent at the sides, the margins of the head behind the eyes sloping to the nearly straight hind margin. Labium large and thin, the hinge reaching posteriorly to the middle of the mesothorax. Legs slender, tibiæ fringed externally with long thin hairs. Wing cases reaching posteriorly as far as the 6th abdominal segment.

Abdomen widest in the middle, depressed, triquetral, the sides regularly curving toward each other at both ends, abruptly terminating at the apex of the 9th segment, which is concave dorsally, and includes the annular 10th segment. Dorsal hooks wanting. Lateral spines minute—excessively minute on the 8th segment, larger on the 9th, where short triangular and convergent at tips. Appendages short, about as long as segments 9 and 10 together upon the dorsal side, superior a little shorter than the inferiors and the laterals one-third shorter than the inferiors.

Median lobe not toothed nor crenate: mental setæ about 13 each side the 4th or 5th (counting from the side) longest: lateral setæ 9: hook very slender, setiform, incurved only at tip: teeth low, each armed with several graduated spinules ''

TRAMEA HAGEN

In the Odonata collection at Cornell University there are three reared specimens and exuviae of *Tramea onusta.* The material, two males and one female, was reared by Dr. James G. Needham at a pond in Laguna Canon, Southern California, August 31, 1922. The nymph of this species has never been described.

Tramea onusta Hagen

The nymph measures in length 24 mm. Abdomen 15 mm. Width of abdomen 9 mm. Width of head 8 mm. Length of ab-

dominal appendages: dorsal 2.5 mm., laterals 2 mm., inferiors 3 mm. Ratio of abdominal appendages: lateral one-third shorter than the dorsal, lateral one-fifth shorter than the inferiors, dorsal one-sixth shorter than the inferiors. Lateral setæ 11 (not counting the small accessory one that is sometimes present just above the hinge). Mental setæ 14–16, outer 2–9 longer and close set, 6 longest. Antennæ with the fourth joint two-thirds as long as the third. It resembles the nymph of *T. lacerata* in general appearance and has less pigment than that of *T. carolina,* as indicated in the following key:

KEY TO THE NORTH AMERICAN NYMPHS OF THE GENUS TRAMEA

1. The 4th joint of the antennæ half as long as the third. No brown spot on the labrum. Lateral setæ 11 .... *lacerata.*
   The 4th joint of the antennæ two-thirds the length of the 3rd .... (2)
2. The dorsal abdominal appendage as long as the laterals. Laterals one-third shorter than the inferiors .... *abdominalis*[1]
   The dorsal abdominal appendage shorter than the laterals .... (3)
3. Lateral setæ 11. Lateral abdominal appendages one-fifth shorter than the dorsals. Laterals one-third shorter than the inferiors. Dorsal one-sixth shorter than inferiors .... *onusta*[2]
   Lateral setæ 10. A distinct brown spot on the labrum. Lateral abdominal appendages one-third shorter than the dorsal. Laterals three-sevenths shorter than the inferiors. Dorsal one-seventh shorter than the inferiors .... *carolina.*
4. Unknown .... *insularis, cophysa,* and *virginica.*

[1] The characteristics of *T. abdominalis* used in this key were taken from Cabot's description of the nymph. The writer has never seen a specimen.

[2] The separation of the nymphs of *Tramea* is a difficult task because, like the adults, the characters distinguishing the species are very slight. The ratios given in the above key for the comparative length of the different abdominal appendages, I believe will hold. However, those for *T. onusta* were taken from three exuvia, two male and one female, and while measurements were exactly the same for these three, a larger series may break them down. I cannot determine from the exuvia of *T. onusta* if the labrum has a brown spot or not, but am inclined to believe that it has not. The counting of the lateral setæ does not include the small accessory one sometimes present just above the hinge.

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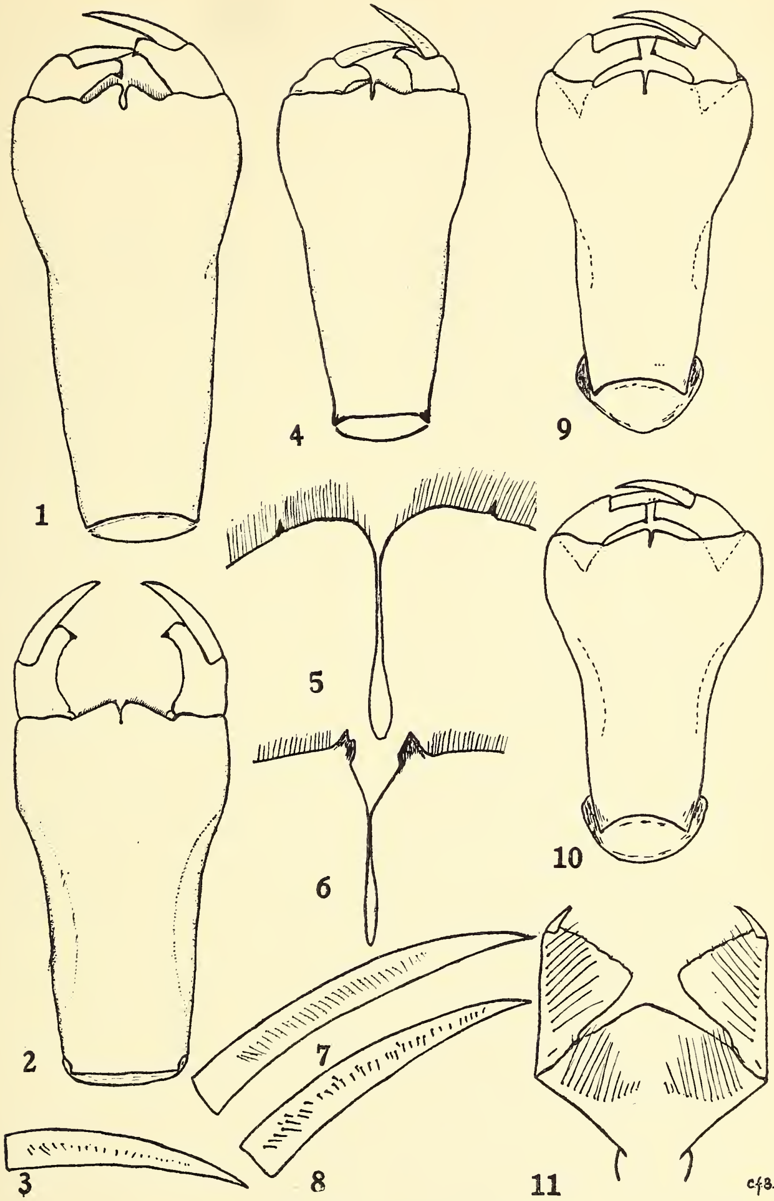
EXPLANATION OF PLATE V

Fig. 1. Labium of *Anax walsinghami.*
Fig. 2. Labium of *Anax amazili.*
Fig. 3. Movable hook from labium of *Anax junius.*
Fig. 4. Labrum of *Anax junius.*
Fig. 5. Distal border of mentum of *Anax walsinghami.*
Fig. 6. Distal border of mentum of *Anax amazili.*
Fig. 7. Movable hook from labrum of *Anax walsinghami.*
Fig. 8. Movable hook from labrum of *Anax amazili.*
Fig. 9. Labium of *Aeschna tuberculifera.*
Fig. 10. Labium of *Aeschna umbrosa.*
Fig. 11. Labium of *Sympetrum pallipes?*



ANISOPTERA NYMPHS

NOTES ON THE FEEDING HABITS OF CARRION BEETLES

By Brandt F. Steele

The general opinion among entomologists seems to be that the beetles of the two genera *Silpha* and *Necrophorus* are beneficial scavengers, feeding entirely upon decaying material. In contrast to this opinion a few observers have noticed the beetles feeding not upon the decaying material itself, but upon the fly larvæ infesting it. Charles U. Clark in The Journal of the New York Entomological Society, June, 1895, p. 61, and Wm. T. Davis in the same Journal, June, 1915, p. 150, both reported this to be the case, but failed to give any experimental data. Some such data obtained at the American Museum of Natural History's Station for the Study of Insects, located at Tuxedo, N. Y., is of interest in this connection.

On July 28, 1926, while watching and collecting carrion beetles on the well-rotted carcass of a woodchuck, I noticed that several of the beetles were carrying fly larvæ in their jaws as they crawled around the dead animal. Closer observation showed that the beetles were coming out through holes in the woodchuck's skin, each with a wriggling maggot between its jaws, and were crawling onto the top of the carcass or out among the nearby leaves where they stopped to devour their prey. This unusual behavior was repeated time after time during the next half-hour that I watched. Four species were seen eating maggots: *Necrophorus, orbicollis, N. tomentosus, Silpha americana,* and *S. novaboracensis.*

Three live specimens of each species were placed in glass-covered plaster boxes, the *Necrophori* in one box and the *Silphae* in another box. Later, in the evening of the same day, about twenty live maggots were turned loose in each box. By the morning of the next day (July 29) every one of the maggots had been eaten; and, in addition, the smallest *Necrophorus tomentosus* had been devoured and the large *N. orbicollis* were in the act of dismembering another of their smaller relatives.

During the day several more maggots were dropped into the boxes and I watched the process of eating through the glass cover. Almost as soon as the food was in the boxes the beetles began a slight waving of the antennae and a rapid movement of the palpi. When, after some moments of crawling around, apparently in search of the maggots, a beetle found one of the wriggling larvæ it seized it fiercely and went into some corner to eat. When the maggot was held by either the head or the tail it was eaten in much the same way as a leaf of lettuce is eaten by a rabbit, the jaws pulling the food in like a machine. Sometimes when the maggot had been seized in the middle it was bitten in half, and the part remaining in the beetle's jaws was eaten as before. The small *Silpha novaboracensis* often seemed to eat only the soft inner parts, leaving the tough outer skin empty and untouched. This was especially true when a large maggot was taken up.

The fact that carrion beetles ate the fly larvæ occurring in the decaying material was no longer doubtful, but this problem arose: Did the beetles actually prefer the maggots to the carrion itself as food? In an attempt to answer this problem eighteen of the beetles, about equally divided between *Silpha* and *Necrophorus,* were placed in a large plaster box and left without any food for three hours. At the end of that time a piece of carrion from which the maggots had been removed was placed at one end of the cage, and a small developer vial two-thirds full of tightly packed maggots was emptied at the other end. Some of the beetles of each genus went immediately to the pile of maggots and began eating. Several went to the carrion, nibbled at it a little bit, but left it almost at once without really eating and went to the pile of maggots. At the end of a very few moments every one of the beetles was eating the maggots; not a one was paying any attention to the carrion.

Another somewhat similar experiment was performed with a mixed group of about twenty-five beetles of the four species mentioned above. They were left to starve from 5:00 P. M. one evening until 11:00 A. M. the next morning. A piece of maggotless carrion was then put in the cage. The beetles walked over it rather disinterestedly, some of them giving it one or two

half-hearted bites. Four hours later, at 3:00 P. M., several maggots were quietly dropped into the cage. There was an almost instant response of increased activity among the beetles; one *Necrophorus orbicollis* and two *Silpha americana* picked up maggots at once. At the end of ten minutes seven *S. americana*, four *S. novaboracensis*, two *N. orbicollis*, and two *N. tomentosus* were eating the wriggling larvæ; and before long all except a few very sluggish beetles had prey in their jaws. Although there was an abundance of food two beetles would occasionally fight over the same maggot, one of them at each end, pulling until one or the other gave up. This experiment seems to indicate a decided preference for maggots, since at the end of an eighteen-hour starvation period the beetles paid little or no attention to carrion, but were nearly unanimous in their choice of the fly larvæ.

In another case a dead, white-footed mouse in which there were no maggots was placed in the cage with half-starved beetles. They came to the carcass a few at a time and began eating around the eyes and mouth. One *N. orbicollis* started to eat rather ravenously at one of the mouse's eyes; but when a maggot was held in front of the beetle's head with a pair of forceps it was seized and immediately devoured. This was repeated with the same result with two other *Necrophori* which were eating around in the mouth. All the beetles, representing the same four species used before, began, with one exception, to eat maggots as soon as the latter were put in the cage. The one exception was a slow moving *Silpha americana* which kept crawling over the mouse's head, taking occasional bites in the mouth of the dead animal.

That these beetles eat carrion can not be denied, for they can easily be seen doing it. One very clear case was observed. The carrion was the comparatively fresh carcass of a large rat. There was not a very strong odor of putrefaction as yet, and although the various species of carrion flies had laid their eggs, there were not yet any maggots except a few very tiny ones which had probably been laid alive. At this stage, before the appearance of any sizable fly larvæ, thirteen specimens of *Necrophorus*, both *orbicollis and tomentosus*, arrived on the scene during a period of five hours. Most of them merely wandered back and forth over the dead body or else crawled and burrowed beneath it.

However, one began eating at the mouth, two at the eyes, and two on the stomach. The first three of these had immediate access to soft flesh, but the two which were eating on the stomach of the rat were confronted with a layer of fur and tough skin. They overcame their difficulty by cutting slits about three-eighths of an inch long through the skin by means of their sharp, heavy jaws; and they were then able to tear off and eat small pieces of the flesh beneath. One striking thing was noticed in this case of the rat, in the case of the white-footed mouse mentioned above, and in one other case where the beetles were seen to eat maggotless carrion with more or less relish. It is that in all three cases the carrion had not yet advanced very far in the process of decay. The flesh was still very similar to that of living animals, and in a strict sense the beetles were not eating putrefying material. That fact makes even more plausible the theory that the beetles prefer maggots as food whenever they are able to choose between the fly larvæ and carrion. This theory is also supported by the fact that captive beetles having only maggotless carrion for food rarely lived over four days, while captive beetles having either maggots alone or carrion which contained maggots lived as long as ten and eleven days. The beetles seem to be able to subsist for only a short time on carrion alone, and do not eat it voluntarily except when it is comparatively fresh.

A device which was made rather crudely and consequently was not very reliable was used to test the preference of the beetles. It consisted of a box in the form of an isosceles triangle, having at each end of the base and at the apex of the triangle a smaller box. Each of these smaller boxes communicated with the main box through a little opening in the side of the latter, and had a screened opening on the side away from the main box. Air could thus pass freely through the whole thing. Different types of food were placed in the two boxes which were at one end of the device and the beetles were placed in the box at the other end. The device was then put in a current of air so that the air passed from the food boxes through the main box into the box where the beetles were, and the beetles tended to follow up the current of air into one food box or the other, supposedly showing a preference for the one in which it stopped.

As stated above, the device was probably not very reliable. The beetles were released in their box one after another at intervals of a few seconds until a group of ten had been released. Only in a very few instances did all ten beetles reach the two food boxes, some of them were almost sure to stop in the main box. Two fairly typical results are as follows:

1. Given the choice between carrion alone and carrion containing maggots, three beetles went to the former and five went to the latter.

2. Given the choice between carrion alone and maggots alone, three beetles went to the former and six went to the latter.

In both instances a slight, though not extreme, preference was shown for the maggots, and this slight preference was fairly constant in all trials. This piece of apparatus doubtless has much greater possibilities than are shown by the little use made of it.

The question of just what it is that carrion beetles do eat and prefer to eat may be impossible to decide, but the data given above certainly seem to indicate that the four species, *Necrophorus orbicollis, N. tomentosus, Silpha americana,* and *S. novaboracensis,* prefer to eat fly larvæ.

SIR JOHN HILL'S "DECADE OF CURIOUS INSECTS"

BY HARRY B. WEISS
NEW BRUNSWICK, N. J.

My interest in the "Decade of Curious Insects" was aroused by reading Prof. L. L. Woodruff's enlightening estimate of the author, which appeared recently in the *American Naturalist* under the title, "The Versatile Sir John Hill, M.D.,"[1] Hill, it appears, was an eighteenth century Londoner, a versatile fellow, characterized in part by Prof. Woodruff as "apothecary, astronomer, physician, editor, botanist, journalist and man of fashion." Among other things he was interested in natural history including insects as such, and part of his activity in this field included the editing of a translation of Swammerdam's classic "Biblia Naturae," published in 1758, which Woodruff says was excellently done. Of his "Decade of Curious Insects," Woodruff does not speak highly, saying that, "Here he is at his worst, apparently giving his imagination free play." This is substantially correct if one judges the work mainly by the illy drawn and ridiculously colored plates, and such was my own impression until I had examined the text. Prof. Woodruff very generously permitted me to use his copy of the book upon which I have made the following annotations.

The "Decade of Curious Insects" is a quarto of twenty-four pages and ten colored plates that was printed in London in 1773, two years before Hill's death. The reverse side of the title page contains the curious statement, "Ladies who may chuse to paint these Insects themselves may have Sets of the Cuts on Royal Paper printed pale for that purpose." A second title page bears the statement, "Insects, Engraved From Nature. Class I. Those Which Have Four Gauzy Wings, and A Weapon, in the Tail. By Gauzy Wings, we understand such as are thin, tender, and transparent: not crusty, as the Beetles; nor leathery, as the

[1] American Naturalist, vol. LX, pp. 417–442, Sept.–Oct., 1926.

Crickets; nor dusty, as the Moths and Butterflies; but *clear*. Such are the wings of common Flies.''

Hill's ''Class I'' includes four ''genera,'' ''Tenthredo, Sphex, Myrmelon, Cynips, and Phryganea.'' In the ''Tenthredo, he discourses on two species, the ''mourning saw-fly, *Tenthredo luctuosa*'' and the ''mottled saw-fly, *Tenthredo variegata*.'' In the ''Sphex,'' the ''comb footed savage, *Sphex pectinipes*'' and the ''Turner savage, *Sphex spirifex*'' are treated. In the ''Myrmelon'' he covers the ''grey ant-eater, *Myrmeleo formicarum*''; in ''Cynips,'' the ''oak leaf gall fly, *Cynips quercus folii*''; and in the ''Phryganea,'' two species, the ''white-wing day-fly, *Ephemera culiciformis*'' and the ''rock day-fly, *Ephemera rupestris*.''

His insects of ''Class II'' are ''those which have four feathery wings.'' Here, only the genus ''Allucita'' is treated, the species being the ''straw-colour'd chinch, *Allucita pallida*'' and the ''tawny chinch, *Allucita fulva*.'' All of the species in both classes are figured.

Hill's method is to give, first the characters of the genus together with some general information and then the characters of the species together with other information about their habits, history, etc., all rather briefly. The descriptions of the adult insects, although they may be true, are of such a general nature as to be worthless for identification purposes and his illustrations are grotesque, from both anatomical and color standpoints. The accompanying reproductions of pages seven and twenty-two illustrate his descriptions.

On the other hand many of Hill's biological statements are substantially correct and examples of these will be shown. Going back to his descriptions, on page four be gives the characters of the ''genus Tenthredo'' as follows:

''The Mouth is form'd of Jaws; and has no Trunk.

''The Scutcheon has two small, distant, elevated points, on its hinder part.

''The Wings lie plain; but are a little puff'd up, and uneven.

''The Weapon at the tail is short; and form'd of two plates, jagged like a Saw; and hollow'd lengthwise in the Female. Plain in the Male.''

Although even for the general reader this is a crude and unscientific description and utterly worthless as a means of identifying the group, yet it contains no gross misstatements. Hill then continues with a general account about insects during the course of which he says, "All two-wing'd Flies have a pair of Plummets behind their Wings," which of course is true. Writing about the "mottled saw-fly," he says, "the egg increases in bigness to twice or more than that, after it is lodg'd in the Plant; nor is this strange since it has no hard covering." It is well known that the eggs of certain species of saw-flies increase in volume after being inserted in the plant tissue.

Of "*Tenthredo luctuosa*" he writes that this is the species mentioned in the "Systema Naturae" of Linnaeus as "*Tenthredo Alni*" and perhaps also the "*Tenthredo ovata*" of the same work, "for Insects are not so numerous, as 'tis the custom now to think them: and colour, tho' an obvious, is no certain character among these creatures; in some it differs with the season; in others, with the sex; in all, it glows according to the creature's health and vigour: in most, it is exalted in the time of courtship, as the feathers on the necks of some Fowls; and in some, it fades, and is lost utterly in dying, as the colours of many fishes." All of which is more or less true, although insect species now are more numerous than most persons think.

In his account of the nest-building wasps he is correct about some nests being made in the ground, some of mud cells under the eaves of houses, their "blood-thirsty" habits, the actions of some in feeding their young from day to day and others in provisioning their nests and then sealing them, but his particulars do not apply strictly to the species he has figured, for he has the larvæ of one of the thread-waisted mud-daubers acting as internal parasites of living and feeding caterpillars.

His illustrations of the adult ant-lion and its larva can be recognized for what they are and his story so far as it relates to the pit made by the larva and of its predaceous habits is authentic. As to galls, he writes, "They arise from a wound made by that Insect (Cynips), who lays an egg there; and in their centre there is a small cavity, within which the Worm lives, that after a time hatches into this Fly." Present-day explanations are not much better as the physiology of gall formation is not understood.

About day-flies or may-flies, he states, "they live about waters, in which they breed; and in their Fly state have so short a term, that it has been the subject of separate histories by Naturalists, and Emblems for moral writers." He comments on the short life of the adults, the deposition of the eggs in water and the aquatic larvæ with their life of one or nearly two years. The shortness of the adults' lives is a matter of record; some species do discharge the contents of their ovaries in one mass in the water and one, two and three years are required for the larval development of various species. According to his "rock day-fly" account, the larvæ live in cases or tubes of "small granules, cemented close," these cases being attached to rocks that stand in the water. However, his illustration resembles somewhat the fish-fly (Corydalinæ) whose larva leaves the water when it is full grown and makes a cell under a stone or other object near the water.

His thrips or "chinches" as he calls them live in various flowers and this is true of many species. His illustrations of two species can be recognized readily as thrips, but it is doubtful if they are the cause of many headaches as stated in his account of "*Allucita pallida.*" Hill says, upon examining them under a microscope, they "were in continual motion; vibrating their Antlers, shaking their Wings, and turning up their Tail to their Heads, in the manner of Earwigs, but with an incredible swiftness," and this is very descriptive of their movements as most entomologists know.

It is difficult to determine how many of the observations noted in the book were really made by Hill and just how far his interest in entomology extended. When he calls the mandibles of an insect the antennæ or antlers and when he makes other mistakes in observation, one is inclined to judge him, perhaps too severely. He was of course familiar with Swammerdam's histories of the ephemera, gall insects, etc., and may have utilized these in the preparation of his book, written undoubtedly for popular consumption. Although some of his digressions seem rather wild and his descriptions meager, his biology whether original with him or not, is on the whole quite fair, and the book may have had some use in entertaining the general reader. The ten species

are not especially "curious" to the informed, although to the uninformed they would very likely have such an appeal.

After writing the above, my attention was called by Professor Woodruff to Doctor H. Hagen's remarks about Hill's book, which appeared in Stettin. Ent. Zeitung, XIV, 1853, under the title "Dr. H. Hagen über John Hill's angeblich erdichtete Insecten." In this, Hagen refers to Hill's work as being known chiefly by the extremely unfavorable criticism of Fabricius, only Percheron raising the question that Hill may have had specimens about which Fabricius did not know. Hagen further states that few of the critics ever saw Hill's book, but that he got a copy and studied it carefully, coming to the conclusion that although it was a poor work even for the time it was published and had no scientific value, it was not written with the intention of deceiving anyone; also that it did not claim to be scientific, as shown by Hill's statement on the reverse side of the title page—"Ladies who may chuse to paint these Insects for themselves may have Sets of the Cuts on Royal Paper printed pale for that purpose."

Hagen says, it is nowhere mentioned that Fabricius had definite information to the effect that Hill's species were imaginary and even if the book seemed crazy and partook of the nature of a scientific swindle, Fabricius' criticism should not have been so strong, because Haller did not believe Hill would be so foolish, and because if Hill intended to deceive, it would have been easier for him to have described exotic insects rather than native ones but little out of the ordinary. Hagen believed that Hill's figures were out of proportion and wrongly colored because the insects were for the most part too large for the microscope and although English microscopes at that time had collecting lenses, these were not achromatic. However, he could not correlate this with Hill's long experience in the practical use of the microscope. Hagen then placed Hill's species, where possible, in their respective orders. He could not make out *Sphex pectinipes* and thought that Hill's *Myrmeleon formicarium* was *M. tetragrammicum,* also that Hill's picture of the larva with its lateral brushes was wrong; that *Ephemera culiciformis* was probably a little stone-fly and that *Ephemera rupestris* although very bad was without doubt a *Phryganide.* He also thought that the descriptions were

as poor as the pictures and notes that Westwood, although characterizing the work as bad, did not think it was written for the purpose of misrepresentation. Hagen closes by calling attention to the fact that although Hill was ignored by Stephens and other of his countrymen, Hill's drawings are hardly worse than Figure 3, Table 6 in Harris' ''Exposition of English Insects,'' from which Stephens without further comment describes a new species *Caenis Harrisella*.

Apparently, he did not believe that contemporary entomologists should have taken Hill's work so seriously, or that it merited severe criticism, written as it was for ''popular'' consumption. Hagen did not mention the biology of the accounts and this perhaps met with his approval. His criticism of Stephens' act in describing a new species from Figure 3, Table 6, of Harris' work is fully justified. The figure in question is a small line drawing from which it would be utterly impossible to draw up an adequate description. However, Harris' illustration is simply small and devoid of detail. It is not out of proportion nor poor in the same sense that Hill's drawings are. It is just inadequate for recognition or descriptive purposes. As an illustrator of his own books and of Drury's ''Exotic Entomology,'' Harris' had a very favorable reputation and his work has nothing in common with Hill's insect caricatures.

The accompanying illustrations are from Professor Woodruff's copy of Hill's book.

A

DECADE

OF

CURIOUS INSECTS:

SOME OF THEM NOT DESCRIB'D BEFORE:

SHEWN IN

THEIR NATURAL SIZE;

AND AS THEY APPEAR ENLARG'D BEFORE

THE LUCERNAL MICROSCOPE;

In which the SOLAR APPARATUS is artificially illuminated.

With their HISTORY, CHARACTERS, MANNERS, and PLACES of ABODE;

On Ten Quarto Plates, and their Explanations.

DRAWN AND ENGRAVED FROM NATURE.

By J. HILL, M. D.
MEMBER OF THE IMPERIAL ACADEMY.

LONDON:
Printed for the AUTHOR, in St. James's-Street.
And Sold by B. White, in Fleet-Street; P. Elmsly, in the Strand; Parker, in Cornhill; Baldwin, in Pater-noster-Row; Ridley, St. James's Street; and J. Balfour, at Edinburgh.

MDCC.LXXIII.

Title Page of Hill's "Decade of Curious Insects"

[7]

II.

MOTTLED SAW-FLY.

TENTHREDO VARIEGATA.

Plate 2.

The Antlers have more than twenty joints; and grow fmall to the point.

The Head is blue; the Trunk is dee pgrey, mottled with yellow · the Body is black.

Plate 2

This is a very ftrange and delicate Fly: 'tis found in damp woods and moors in Auguft and September.

The Head is of a fhining blue.
The *Eyes* are green.
The *Antlers* are amber-colour'd.
The *Feelers* fhort, and brown.
And the *Jaws* of a yellow brown.

The Trunk is of an iron-grey, mottled with irregular fpots of gold, like the womens tambour-work in embroidery.
The *Scutcheon* is entirely raven-grey.
The *Points* on it are black.

The Body is coal-black above, and raven-grey below.
The *Lines* dividing the rings are brownifh.
The *Air-holes* are black.

The Legs are of a fine bright yellow, with black claws.

The Wings are brown, with a dufky edge.

The Tail is amber-colour'd.

I received

Page 7 of Hill's "Decade of Curious Insects"

1. THE STRAW-COLOUR'D CHINCH.

ALLUCITA PALLIDA.

Each wing is compofed of one diftinct undivided feather.

Plate 9.

This is a creature very ftrange in its nature, and hiftory; and which once came as ftrangely before me. A ftudious gentleman, very fubject to the head-ach, which he, and his phyfician, both attributed to great attention; fneezing one day with violence, as he was writing, faw fome atoms a moment afterwards upon a fheet of white paper that lay upon his table; and they plainly moved: he doubled up the paper, and brought it to me: when we laid a parcel of their moving particles before the lucernal microfcope, they appeared of the fize and figure reprefented at Plate 9; and were in continual motion; vibrating their Antlers, fhaking their Wings, and turning up their Tail to their Heads, in the manner of Earwigs, but with an incredible fwiftnefs.

'Twas palpable they had been difcharged from his nofe; and 'tis very eafy to fee whence they were thrown, and to underftand how they might have caufed intolerable pain, while they were thus raifing and moving their irritating hairs, and feathers, upon a part where the very fubftance of the brain is almoft naked.

I had feen the fame Species inhabiting the Flowers of the Plant Mignonette; and on afking, found he had that Plant in his chamber.

The Head of this creature is lemon-colour'd.
Its *Eyes* are of a delicate blue.
The *Studs* over them deep black.
Its *Antlers* are of the paleft brown, but ruddy at the bafe of each Joint.
The *Feelers* are pale, and fmall.

Its Trunk is of a pale ftraw-colour.
The *Scutcheon* has a tint of greenifh.

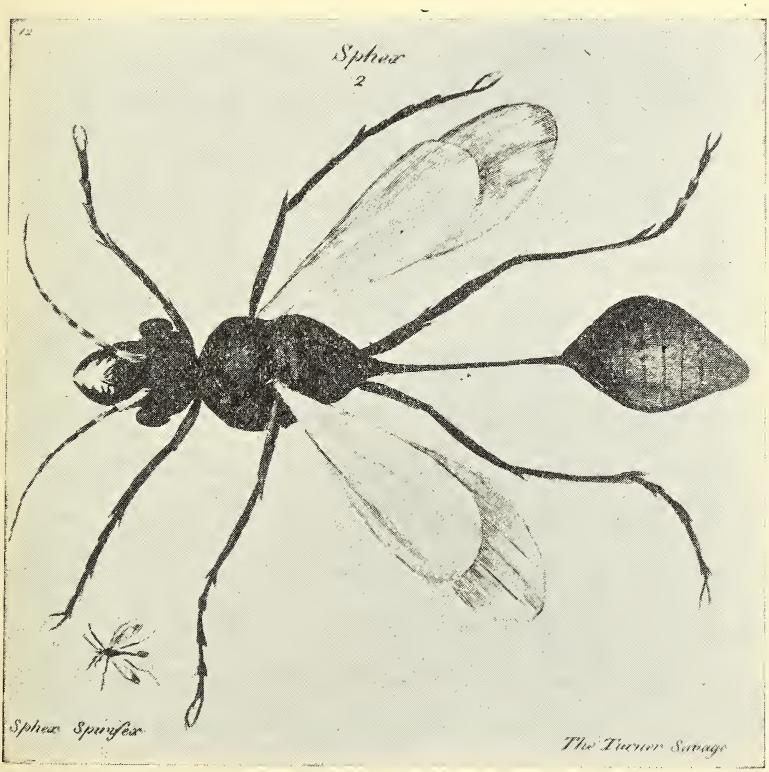
Its Body is very pale ftraw-colour.
The *Rings* dividing it are whitifh.

Its Legs are pale brown, but deeper at the joints.

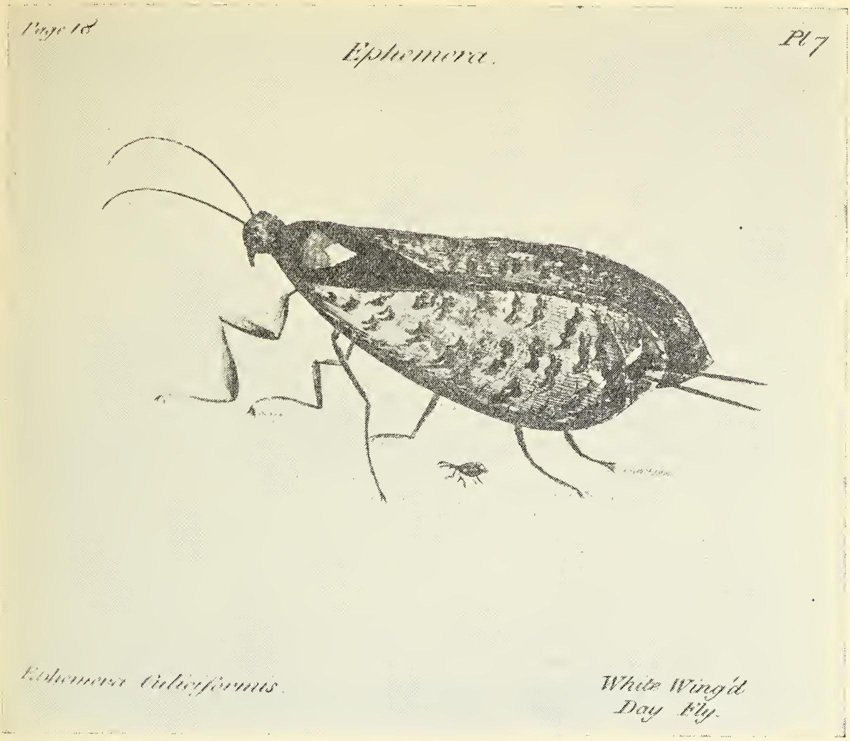
Its Wings are whitifh, with a dufk of brown.

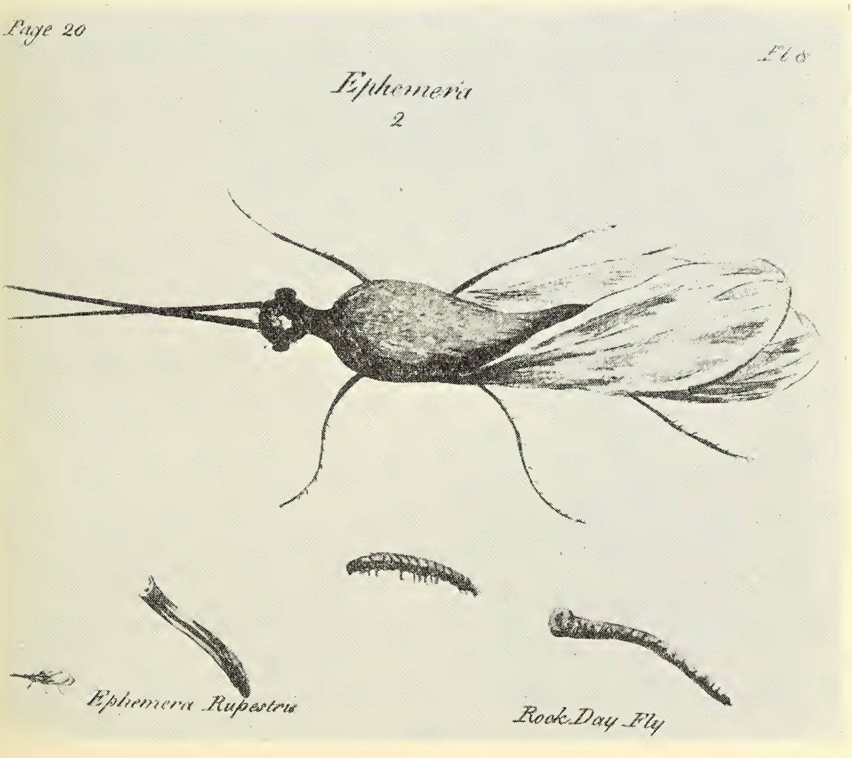
Its Tail is amber-colour'd.

2. THE



PLATES 2 AND 4 OF HILL'S "DECADE OF CURIOUS INSECTS"





Plates 7 and 8 of Hill's "Decade of Curious Insects"

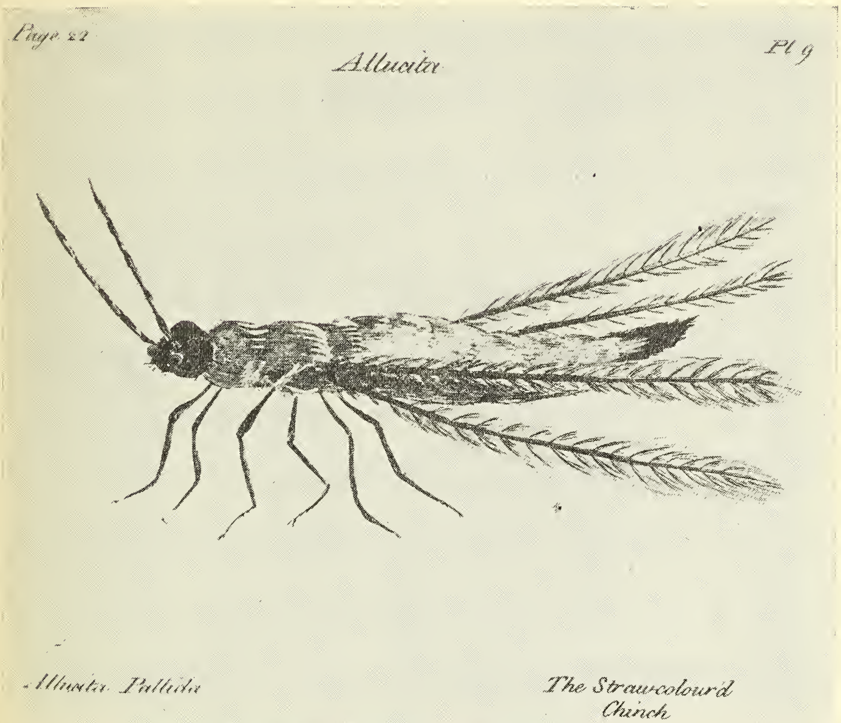


Plate 9 of Hill's "Decade of Curious Insects"

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF DECEMBER 1, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. on December 1, 1925, in the American Museum of Natural History, President Frank E. Lutz in the chair, with nineteen members and twelve visitors present.

A letter from Dr. Tower announcing the annual dinner of the New York Academy of Sciences was read.

A letter from Mr. J. W. Decker, Callahan, Fla., inviting his fellow members to visit him, was read.

Mr. Davis announced the death on November 27 of Lewis B. Woodruff, a life member and former member of the Society. He spoke of his excellent work as a naturalist and of his amiable personality and expressed the regret, shared by all present, at his death at 57 years of age. He stated that he had attended the funeral at Litchfield, Conn.

Dr. Lutz added his tribute, speaking especially of the labors of Mr. Woodruff in the Virgin Islands.

Dr. Leale also spoke in appreciation of his fine qualities which he said were remarkable also in other members of his family.

The secretary was instructed to write his cousin Judge James Parsons Woodruff, expressing the Society's regret.

Dr. Lutz introduced Dr. Adopho Lutz, of Rio de Janeiro, who briefly expressed his pleasure at being able to visit the American Museum and upon the prosperity of the New York Entomological Society.

Mr. Hartzell, under the title "The Relation of Entomology to the Study of Plant Diseases at the Boyce Thompson Institute for Plant Research," described the Institute founded by Col. Thompson, its endowment, equipment and staff of thirty-three investigators, using lantern slides to illustrate the splendid greenhouses and other appliances. He stressed the cooperation between pathologists and entomologists aimed for in the Board of Scientific Advisors and described some of the work initiated in studying mosaic diseases. *Cicadula sex-notata* was especially studied as the carrier of aster yellows.

Miss Irene D. Dobroschky spoke of the particular work assigned to her by Dr. Kunkel, in charge of pathological division, including 200 plants subject to mosaic disease and the insects, principally Coleoptera and Hemiptera, regarded as carriers of the disease. She advanced the idea that, while the carrying might be purely mechanical in the case of biting insects, there was a possibility of its being also biological in the case of sucking insects.

Dr. Lutz complimented Miss Dobroschky as the first woman to present such a study before the Society and expressed his admiration of the facilities provided at the Boyce Thompson Institute.

Mr. Bird spoke of "The Gynecological Travesty with the Dipteron *Pseudolfersia maculata*" illustrating his remarks with specimens of the fly. After the fly was killed a puparium was found in the cyanide bottle or a full grown larva which immediately changed to a pupa.

Dr. Sturtevant and Mr. Davis discussed the subject of living maggots being deposited by Diptera and Dr. Lutz added some of his experiences.

Mr. Davis exhibited *Vanessa milberti* and the variety *subpallida* and gave a number of data indicating its appearance late in the season and its being less rare this year than usual.

Dr. Lutz, Mr. Watson and Mr. Goldfisher added data indicating its greater abundance northward and especially this year. Mr. Goldfisher had a record October 16 at Columbia University.

Society adjourned.

MEETING OF DECEMBER 15, 1925

A regular meeting of the New York Entomological Society was held at 8 P. M. on December 15, 1925, in the American Museum of Natural History, President Frank E. Lutz in the chair, with twenty members and five visitors present.

F. R. Swift, 205 Brookside Ave., Mt. Vernon, N. Y., and H. L. Taylor, 408 Clifton Ave., Newark, N. J., were elected members of the Society.

The president appointed as a nominating committee Messrs. Sherman, Weiss and Schwarz.

A letter from Judge James P. Woodruff was read and Mr. Davis spoke also in reference to the death of Lewis B. Woodruff.

Mr. Angell stated that Mr. Howard Notman had purchased the collection of the late Gustav Beyer.

Mr. Davis exhibited a collection of cicadas which he had identified for the U. S. National Museum, including specimens collected fifty years ago. He said that 134 species and subspecies were now known from America north of Mexico, grouped into 18 genera. He gave the characters of each group and interesting details of many species. It is remarkable that the life period is still unknown for most. He showed also some western species collected by Messrs. Engelhardt and Chamberlin; and Chinese and Japanese ones received from Mr. Johnson.

Mr. Johnson said that collecting cicadas and making individual cages for them was a profession in China where they were esteemed as songsters. Bamboo poles, forty feet long, provided with a flannel cloth smeared with a very sticky preparation, were brought near the cicada perched aloft. A sudden motion of the pole throws the cloth around the cicada. The wings are usually torn and damaged.

Mr. Swift spoke of the development of the bot fly as observed in an individual intentionally raised in the calf of his own leg. Thirteen to

fifteen eggs were laid on grass blades or leaves, sticky and destined to be carried to some warm-blooded animal by mosquitoes or flies. On August 25 he put a maggot hatched from such egg near an unhealed wound. The maggot entered the wound, a hard cyst formed and three days later itching began, followed September 2 by a discharge. By September 10 the maggot began to feed in the muscle, with a burning sensation. For the next two weeks his general health was affected, especially in lack of energy and profuse perspiration. The discharge from the air vent in the cyst which had been a thin yellow serum became a thick almost black blood, with pus. On September 29 the maggot moved up to the surface, the cyst puffed out with intense itching. In October the leg was swollen and inflamed at times when there were discharges of hot liquid which burned the flesh and stained through heavy khaki trousers. October 23 the maggot rolled out onto the floor 2 cm long, buried in moist earth 8 cm deep, and became a fly November 25. The hole in Mr. Swift's leg healed in three weeks and the itching and aching became a memory. The experiment though painful was a success, for as he expressed it ''I was determined I'd get me one.''

Mr. Swift added that the usual treatment with a knife to remove the bot fly was unnecessary for they could be killed with chloroform and rolled out without enlarging the wound.

Mr. Ragot recorded *Vanessa milberti,* a worn specimen, seen in Long Island City, on December 9.

Dr. Lutz exhibited Imms' General Text Book of Entomology.

Mr. Frankenstein, present as a visitor, showed microscopic mounts of ♂ Stylops, parasitic on Hymenoptera.

Society adjourned.

Meeting of January 5, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M. on January 5, 1926, in the American Museum of Natural History, President Frank E. Lutz in the chair, with twenty-five members and three visitors present.

On motion of Mr. Olsen, a vote of thanks was tendered to Mr. Davis for his long and efficient service as treasurer.

The nominating committee submitted its report and there being no other nominations the secretary cast one affirmative ballot, thereby electing the following:

OFFICERS FOR THE YEAR 1926

President, Frank E. Lutz, American Museum of Natural History, New York.

Vice-President, Henry Bird, Rye, N. Y.

Secretary, Chas. W. Leng, Public Museum, Staten Island, N. Y.

Treasurer, Wm. T. Davis, 146 Stuyvesant Place, Staten Island, N. Y.

Librarian, Frank E. Watson, American Museum of Natural History, New York.

Curator, A. J. Mutchler, American Museum of Natural History, New York.

Executive Committee

H. G. Barber   Harry B. Weiss   Herbert F. Schwarz

Publication Committee

Harry B. Weiss   F. E. Lutz   John D. Sherman, Jr.
C. E. Olsen

Delegate to the New York Academy of Sciences
Wm. T. Davis

The President appointed as Auditing Committee E. L. Bell, Wm. F. Lawler, Jr., Dr. E. R. P. Janvrin; as Field Committee, A. S. Nicolay, E. Shoemaker, and as Program Committee, A. J. Mutchler, H. B. Weiss, Dr. A. H. Sturtevant.

The President announced that under the will of the late Lewis B. Woodruff the Society would receive a bequest of $10,000; and that Hawkins, Delafield and Longfellow would attend to the interests of the Society in the probate proceedings, sending in due course such papers as it may be necessary to execute. He read the paragraphs of the will affecting the Society, as follows:

> "I give and bequeath to the New York Entomological Society (Inc.) the sum of ten thousand dollars ($10,000) to be added to its "Permanent Fund." While intending in no way to impose upon said Society any conditions with respect to this gift, or any binding restrictions respecting the use of the income derived therefrom, I would suggest that this legacy be invested in some conservative income producing property or securities, and that its income be devoted primarily to the publication of technically illustrated monographs of groups within the field of the Society's present authorized activities, such income to be allowed to accumulate, if necessary, to that end; and that a memorandum of this suggestion, if it meets with the Society's approval, be filed with the permanent records of its treasurer.
>
> "I direct my executor to have my scientific library appraised at the expense of my estate, suggesting for that purpose my friend, John D. Sherman, Jr., now of 132 Primrose Avenue, Mount Vernon, N. Y., and before attempting to make other disposition of it, first to offer and dispose of the several items thereof at one half their respective appraised valuations to the members of the New York Entomological Society and the Linnaean Society of New York who may desire the same for their own use and not for resale, such offer to be made through the respective secretaries of such Societies."

On motion by Mr. Barber, as chairman of the Executive Committee, the following resolution was adopted:

Resolved, that the president, Dr. Frank E. Lutz, be and hereby is authorized to sign for the Society any and all papers required in connection with

the bequests of Lewis B. Woodruff, and to affix thereto the seal of the Society.

The librarian reported accessions.

Mr. Charles Louis Ragot, 21 Floyd St., West New Brighton, Staten Island, was elected a member.

Mr. Leng, under the title ''Our Changing List of Coleoptera,'' compared the Crotch List of 1,873 listing 7,450 species with the MSS Supplement of 1925 bringing the total up to 21,000 names, and pointed out the causes of the increase, *viz.*, the activity of Col. Casey, the study of obscure groups like Aleocharinæ, and of distant regions like the Mexican border, but most of all the finer discrimination leading to the description of many subgenera and subspecies. He questioned the advantage of loading the catalogue with varietal names and recalled, as equally applicable now, Schaupp's plea in 1880 ''we need short, clear, synoptic tables of the known species, giving the principal characters of those species, their size, and locality.''

His remarks were discussed by several members, among whom Mr. Schaeffer who said one name might with advantage be removed, *Licinus silphoides*, because years had passed since a single specimen had been found in Massachusetts.

Mr. Nicolay gave an interesting account of ''Beetling in the White Mountains during July,'' illustrated by specimens and photographs. *Sphaeroderus brevoorti*, *Carabus groenlandicus*, *Notiophilus nemoralis*, *aquaticus* and *borealis*, and many other interesting species rewarded the efforts he and his companions, Messrs. Quirsfeld and Mason, had exerted. Icy winds, black flies, and mosquitoes had, however, lessened the pleasure of the trip, and the loss of all his traps by the depredations of wild animals had been a disappointment.

Mr. Davis spoke of the wasp *Bembidula quadrifasciata* Say and some of its habits. His remarks will be printed in full.

Dr. Lutz and Mr. Schaeffer discussed the best season for collecting at Brownsville, Texas, which Mr. Schaeffer considered to be June.

The interesting captures made in South Alabama by Mr. Loding and Dr. Bequaert were also discussed.

Meeting of January 19, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M., in the American Museum of Natural History, Vice-President Henry Bird in the chair, with eighteen members, and nine visitors present.

Mr. Tee Van exhibited ''Insects collected at Sea by the Arcturus Expedition,'' consisting of species of the water strider *Halobates* actually living at sea, twenty or more land insects found at sea, some even 150 miles from land, and a number of insects found on the Cocos and Galapagos Islands. With lantern slides he showed the route of the Arcturus and the methods used in collecting and studying the organisms on board the vessel. He pointed out many items in the life history of *Halobates* not yet ade-

quately studied and several members joined in the discussion that followed especially as to the diving habits.

Mr. Ragot showed a ''New Exhibition Box for Insects'' which was arranged with strips of mirror, so that pins might be inserted between the strips, thus permitting a perfect reflection of the underside. The butterflies selected for exhibition also showed some of the interesting features of Mr. Ragot's summer collecting on Staten Island, *viz.*, *Basilarchia astyanax v. albofasciata*, *Euptoieta claudia* in numbers, *Eurymus eurytheme*, etc. The labels on Mr. Ragot's specimens were photostat reduced reproductions of typewritten, by which process he pointed out that 1,000 labels could be procured in an hour at a cost of twenty cents.

Mr. Mutchler exhibited for Mr. Frank Johnson a box of *Ornithoptera* butterflies ♂ and ♀ of extraordinary size and brilliant color.

Dr. Gehring, of Bethel, Maine, present as a visitor, spoke of his association 50 years ago with E. A. Schwarz in the latter's third trip to Florida. Savannah, Fernandesia, Cedar Keys, Tampa, where they lived in a cabin on the Hillsboro River for a month, then across the state to Enterprise, and New Smyrna, were the places visited. He described Mr. Schwarz as being scant of hair but full of joy when *Spalacopsis* or *Zuphium* rewarded his efforts, and continually singing Lorelei, even when, as at New Smyrna, raw tomatoes and crackers constituted the menu. Some incidents that Dr. Gehring recalled were finding *Pasimachus* early in the morning in irrigation ditches, the abundance of whip scorpions locally called mule-killer because often found under the saddle cloth of dead mules, the abundance of egrets and parrakeets, and the roaring of bull alligators at night. He said that Mr. Schwarz was at that time determined to give his life to science and also spoke of his later years having been quietly marked by assisting many younger men in colleges and otherwise.

Dr. Gehring spoke also of the great skill of Charles Dury as a collector leading to the creation of the verb to duryize for the finding of supposedly rare species in numbers.

His remarks were highly appreciated, many members recalling other memories germane to his subject. Mr. Davis described the piles of wood kept in orange groves to burn against a threatened frost and the whip scorpions found beneath them, locally known as ''vinegaroons.'' Mr. Tee Van spoke of other scorpions of British Guiana as being exaggerated in respect of deadliness. Their sting was deadening in the effect for an hour but not fatal.

MEETING OF FEBRUARY 2, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M., in the American Museum of Natural History, President Frank E. Lutz in the chair, with twenty-six members and nine visitors present.

Mr. Hall exhibited several boxes of butterflies from the Wind River Range, Wyoming, and spoke in detail of the distribution of Lepidoptera in different zones of altitudes.

In the lower zone, including the sage brush plains, characteristic species were *Euphydryas gilletti, Heodes rubidus,* and *Cercyonis alope-nephele*; in the middle zone, *Erebia sophia* and *Brenthis frigga*; in the upper zone, *Erebia magdelina* and *Brenthis pales*; while *Aglais milberti* was found in all zones. The character of each zone was shown by photographs, and it was pointed out that at 1,000 feet snow and ice replaced butterflies except for straggling visitors.

In the discussion which followed it was brought out that the total expense of a three weeks' trip from New York to the Wind River Range, southeast of Yellowstone National Park, was about $330.

Prof. A. F. Huettner spoke with illustration by lantern slides, on "The Maturation and Early Development of the Insect Egg." He pointed out first the latent danger to agriculture in the enormous number of eggs produced by the female, and then proceeded to show the male parts by which the fertilizing sperm is produced and the female parts producing and conveying the egg. The egg itself, consisting mainly of food material, was then shown with its micropyle through which the sperm, propelled by its whip-like thread, gains access. The development of the egg after such fertilization was then shown including the results of more than one sperm becoming involved. It was suggested that a consequence of two sperms uniting with a single egg might be a gynandromorph; and several such in Drosophila closed the series of illustrations.

Dr. Lutz, Dr. Sturtevant and Mr. Watson joined in the discussion of the subject, particularly in reference to the beautiful sculpture of the eggs to which Prof. Huettner had alluded.

At the request of Mr. Watson, Carl Heinrich's editorial in the current issue of the Proceedings of the Entomological Society of Washington was read.

Mr. Leng called attention to an error in the Zoological Record for 1922, by which *Ababa crinita* Csy., is erroneously credited to Borchmann.

MEETING OF FEBRUARY 16, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M. on February 16, 1926, in the American Museum of Natural History, President Dr. Frank E. Lutz in the chair, with twenty-one members and seven visitors present.

Mr. Stephen Thomas, 240 West 71st St., was elected a member.

Mr. Davis reported progress on New York State List of Insects, reading a letter from Prof. Crosby.

Mr. Bell gave an account of his experiences in collecting butterflies, and other insects, at and in the vicinity of Mobile, Alabama, during the last of August and the first of September, 1925; he exhibited a few of the more interesting *Hesperiidae,* collected by him in that locality.

Mr. Engelhardt gave an account of "Reconnoitering the Deserts of Southern California and Arizona," with Mr. W. J. Chamberlin, of Corvallis,

Oregon, in an automobile which was like a traveling hotel. At Santa Barbara they visited Mr. Fred Winters, at Yuma they met with two students of Prof. Harned's, at Phoenix they met former companions of Mr. Glick, and there and at Tucson found entomological stations. Camping in the Santa Rita mountains a trap lantern yielded at least 1,000 moths and throughout the trip, while there was often an absence of life during sunlight hours, insects were found at night and wherever water occurred. Two interesting boxes of insects were shown, and Mr. Engelhardt had time only to speak of the cicadas, grasshoppers, *Scaphinotus catalinae* and Monilenna of which Mr. Chamberlin collected about a quart on cactus after rain, when trouble with the electric light ended the meeting.

ERRATA

Vol. XXXIV, page 295, in the Key to Subfamilies, for "3(5)" read "3(4)."

Vol. XXXIV, page 297, between "WILLIAMSIANA" and "Subfamily CENTROTINAE" insert "26(1). Margins of clavus nearly parallel, not narrowed toward apex; corium with 2 discoidal cells, ulnar vein forked far from base; pronotum convex, unarmed; scutellum transverse, apex truncate; ocelli far from each other, near base of head........ABELUS Stal."

Vol. XXXIV, page 297. Line 5 from bottom, for "1(38)" read "1(36)."

Vol. XXXIV, page 298. Line 7 from bottom, for "16(37)" read "16(35)."

Vol. XXXIV, page 298. Line 5 from bottom, for "17(34)" read "17(32)."

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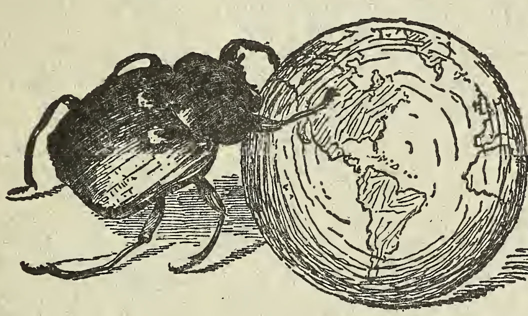

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JOURNAL

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New York Entomological Society

VOL. XXXV JUNE, 1927 No. 2

CENTRAL AMERICAN STONEFLIES, WITH DESCRIPTIONS OF NEW SPECIES (PLECOPTERA)

BY JAMES G. NEEDHAM AND ELSIE BROUGHTON

This paper is a re-characterization of the old species of stoneflies from Central America and Mexico, together with descriptions of a few new ones. Since the publication of Pictet's *Hist. Nat. Neuropt: Perlides* in 1842 there has been hardly any progress in the knowledge of this fauna. The sketchy colored figures of Pictet's plates, while of some assistance in the recognition of species, do not show the characters in venation and in genitalia that have since come to be regarded as truly diagnostic; nor do the descriptions mention these characters. Moreover, all the known species of this entire region belong to a single genus that has never been adequately characterized or illustrated.

When the Neuroptera volume of *Biologia Centrali Americana* was issued, the senior author, then being interested in stoneflies, wrote Mr. Godman asking whether any had been collected for this great work, none being mentioned in it. In reply Mr. Godman sent a small box of them, saying that no one had been found to work them up for that publication. He suggested that the inquirer work them up at his convenience, publishing where he pleased, and making whatever disposition he pleased of the specimens.

The box contained a score or more of pinned specimens. They were a sorry looking lot—even worse bedraggled, shrivelled and faded than the average collection of pinned stoneflies. Aside

from a few notably large specimens and one notably small one, they all looked alike superficially; and when one examined the shrunken genitalia, no two of them looked alike!

No opportunity for doing the work required for a proper study of this collection came until recently, when the junior author joined in the undertaking.

We have been able to identify nearly all the regional species of the older authors and to characterize both sexes of several of them (though in our collections females are more abundant), and to describe the nymph and the egg as well.

All the stoneflies of this region appear, singularly enough, to belong to a single genus,* *Anacroneuria*. This genus was proposed by Klapalek in 1909 (*Wiener Ent. Zeitung* 28: 227–8). It was based largely on genital characters of the male which have not been hitherto illustrated nor adequately described. Klapalek laid stress upon the presence of a percussion disc on the prolonged ninth ventral segment of the male, but that has proved of minor importance, being lacking in at least one species (*A. dilaticollis*). The upturned subgenital hooks developed from the subanal plates are however a much better character.

The genus is well marked by three characters that will apply to both sexes:

1. Two ocelli.
2. The sinuate course of the second anal vein, at first approximated to the first anal, then diverging from it and thereafter pectinately branched and not connected with the third anal by a crossvein.
3. The basal cubito-anal crossvein in the fore wing when developed, is situated well beyond the anal cell.

The genus is dominant throughout the Neotropical Region. A very large number of species have been described from South America by Enderlein and Klapalek. It will be no easy task to identify them: for Klapalek has given no illustrations of any

* *Perla aurantiaca* Hagen was put by its describer in the "subgenus Isogenus" (*Synops. Neur. N. Amer.*, p. 19, 1861) because of four upcurving branches to the radial sector; but its lack of a median ocellus excludes it from Isogenus and allies it, also, with Anacroneuria.

of his new species and has not even stated the sex on which some of his descriptions are based; and Enderlein's small outline figures of female subgenital plates show such slight differences as can hardly be of specific value. The edge of this plate varies in form and is subject to great distortions in drying.

All of the specimens on which this paper is based are in the Cornell University collection. Three of the described regional species remain unknown to us: *Perla aurantiaca* Hagen mentioned in a preceding footnote, *Neoperla gautemalensis* Enderlein and *Perla litura* Pictet, which last we think may be a synonym of the very variable *Perla dilaticollis* Burmeister. The remaining species, including the new ones, may be separated as follows:

KEY TO SPECIES OF CENTRAL AMERICAN AND MEXICAN ANACRONEURIA

1.—Femora black and yellow, the color areas sharply delimited........ 2
—Femora brownish or paler with darker areas ill defined or wanting..... 3
2.—Prothorax black........ *aethiops*
—Prothorax yellow........ *naomi*
3.—Tails ringed........ *annulicauda*
—Tails not ringed........ 4
4.—Head with a sharply defined quadrangular black spot above including the ocelli........ *blanda*
—Head pale or diffusely blackened over the ocelli........ 5
5.—Head black-bordered above, with a large oval yellow crown spot including the ocelli; wings dark brown........ *coronata*
—Head not so, middle area darker; wings yellowish........ 6
6.—Subgenital plate of females rather squarely truncate, with a small median notch........ 7
—Subgenital plate of female four-lobed........ 8
7.—Large species; fore wing 18 mm. (♀)........ *cincta*
—Smaller species; fore wing 11–13 mm. (♀)........ *dilaticollis*
8.—Inner pair of lobes on apex of subgenital plate of female, broad and ill defined........ *nigrocincta*
—Inner pair of lobes on apex of subgenital plate of female, small but well defined........ *sulana*

Anacroneuria annulicauda Pictet

1842. *Perla annulicauda* Pict. Perlides, p. 249, Pl. 22, fig. 1–4.
1852. *Perla annulicauda* Walker, Catalog, p. 160.
1861. *Perla annulicauda* Hagen, Syn. Neur. N. A., p. 26.
1909. *Neoperla annulicauda* Enderlein, Sitzb. Natur. Freunde, p. 175, fig. 8.

This species may be designated as the type of the genus. Our material comes from Brazil. We have none from Mexico, whence others have reported it. We have seen no male of the species, but are able to present a fuller characterization of the female than has hitherto been available.

Color tawny yellowish. Head obscure brownish above, darker before the ocelli and on the lappets that overlie the bases of the antennæ. Palpi brownish; antennæ brownish beyond the pale basal segment, becoming somewhat paler toward their tips. Prothorax rather uniform tawny yellow, hardly paler in the median area of the disc and along its lateral margins. The side margins of the disc are at first parallel and then strongly convergent posteriorly to the hind margin. Wings tawny, subhyaline, with somewhat darker veins. Legs yellowish, only the narrow transverse knee caps and the tarsal pulvilli brown.

Abdomen tawny; tails brownish, annulate with paler on the small basal divisions of the segments; the extreme base yellowish. The subgenital plate of the female is four-lobed; the tips of the smaller lobes of the inner pair are divergent; on the slightly produced and bilobed ninth segment are three patches of spinules, a larger pair on the lobes and a smaller one of finer spinules on the median line between the others (Fig. 1). The egg is of the usual oval form, with a low button-shaped micropylar cap upon the larger end.

Length of fore wing 17 mm. Rio Brazil.

Anacroneuria sulana new species.

Color dull yellowish varied with obscure brownish. Antennae brown including the basal segment. Maxillary palpi brown; labial palpi paler. Head yellow, with a median brownish streak joining two brownish crossbars, the anterior one ending on the lappets that cover the bases of the antennae, the posterior broader one enveloping the ocelli and tubercles and extending to the inner margin of the eyes. Rear of head yellow.

Prothorax pale brownish, with a narrow black marginal line across the front, two broad yellowsh longitudinal stripes upon the disc, separated by a narrower brownish middorsal stripe. This median stripe is in turn divided by a very narrow median pale line. The width of the prothorax is nearly twice its length, and the straight sides strongly converge toward the rear margins. Wings subhyaline, tawny yellow, with somewhat darker veins. Legs tawny or pale brown with blackish knee caps. The tips of the last tarsal segment including claws and pulvilli also are blackish. Base of legs

yellow as far out as the middle of the femora on the front legs and almost to the knees on the hind legs.

Abdomen tawny yellowish. Tails pale brownish, yellowish at base. Subgenital plate of the female four-lobed, the inner pair of lobes minute and apparently rather variable in form (see figs. 2 and 2A). The median area of the ninth sternite has a bare spot on its apical margin in the midst of its field of spinules. The eggs of this species are shown in fig. 3B.

TYPE. A female from Rio Santa Ana, British Honduras, collected by Karl P. Schmidt (Fig. 2). The female whose plate is shown in Fig. 2A is in the Godman collection from Paso del Macho. In the same collection are two other females, one from Chinadaga, and one from Sula.

Anacroneuria nigrocincta Pictet

1842. *Perla nigrocincta* Pict. Perlides, p. 236, pl. 22, figs. 508.
1852. *Perla nigrocincta* Walker, Catalog, p. 158.
1861. *Perla nigrocineta* Hagen. Synops. Neur. N. A., p. 24.

Very variable in size, the length of fore wing ranging from 11 mm. and 12 mm. in the smallest males to 18 mm. in the largest females.

Color obscure tawny brownish, little varied. Head brown above with a round median pale spot replacing the middle ocellus. A paler area between ocellus and eyes extends around behind the eye to the hind angle of the head. Antennae brown except the paler basal segment. In boiled specimens the joinings between segments are paler, giving the whole organ a narrowly ringed appearance. Palpi brown.

The prothoracic disc is obscurely striped having border of brown, then two paler lateral stripes and then a median stripe of brown that is divided longitudinally by a fine pale line. The thin sharp edges are strongly convergent backward and the front angles in the female appear to be obliquely truncated Wings subhyaline tawny yellowish, with somewhat darker veins. Legs yellow with black knee caps; a wash of brown extends obliquely inward therefrom half the length of the femur, and wholly covers the tibia externally, and also the last joint of the tarsus.

Abdomen tawny yellow. Tails brownish. The ninth sternite of the male is produced backward in a rounded lobe half the

length of the tenth segment and bears beneath a bare nipple-shaped hammer near its apex (Fig. 3). The tips of the hooks formed by upcurving subgenital plates are obliquely eroded, with a pair of sickle-shaped tenacula near its tip whose apices lie superposed.

The subgenital plate of the female is obscurely four-lobed; the inner lobes are low and broad, and the outer ones are longer. At their outer edges they are variously infolded in different specimens, presenting variety of aspect (Fig. 3A, B). The median area of the ninth sternite is well covered with convergent spinules.

This species appears to be of general distribution. It is well represented by specimens of both sexes, in the Godman collection. The localities are as follows:

Mexico
- Atoyac, ♂ and ♀
- Capetillo, ♂
- Chiapas, ♂
- Chilpancingo, ♂
- Cuernavaca, ♂
- Cuidad, ♀
- Orizaba, 4 ♂s
- Pancina, ♂ and ♀
- Rinco, ♀s

Guatamela
- Duenas, ♀
- Purula, ♂ and ♀
- Zapote, ♂ and several ♀s

Nicaragua
- Chontales, ♂

Costa Rica
- Irazu, ♂

Honduras
- Rio Santa Ana, ♂
- Rio de Janeiro.
- Chapada.

A female of what appears to be another allied species from Chapada is represented in figure *3A*. It is a defective specimen inadequate for description. Another similar female, likewise defective, comes from Chapada. Both are in the Godman collection.

Anacroneuria cincta Pictet

1842. *Perla cincta* Pict. Perlides, p. 227, pl. 20, fig. 5.
1852. *Perla cincta* Walker. Catalog. B. M., p. 156.
1861. *Perla cincta.* Hagen. Synops. Neur. N. A., p. 24.

Length of fore wing, 18 mm. ♀

Color tawny yellow varied with brown. Head brownish above with a very obscure pale transverse M-mark in front of the ocelli, and a paler area encircling the ocelli except in front and extending laterally almost to the hind angles. The eyes are bordered with brown. Antennae blackish, including the basal segment. The joinings are paler in the boiled specimens, giving a narrowly ringed appearance to the flagellum. Palpi brown.

Prothorax widest in the middle, narrowed thence slightly forward and strongly to rearward. In the color it is longitudinally striped with lighter and darker brown. The darker predominates except in the median area where a pair of brown stripes are narrowly separated by a paler one: they are bordered laterally by broader paler ones. On the sides of the disc there are some obscure embossed markings and there is a diffuse paler area adjacent to each anterior angle. The wings are tawny yellowish subhyaline, with darker veins. The legs are pale brownish with black knee caps. The tips of the tibiae and the last segment of the tarsi are darker brown.

The abdomen is pale brownish, with tails of the same color. The subgenital plate of the female overlaps about half of the ninth sternite below, is rather squarely truncate, and has in the middle an acute notch. the shield-shaped spinulose area of the ninth sternite occupies the middle third of its breadth except for a small median apical bare patch (Fig. 4). It forms a broad T in outline by reason of a narrow stalk-like extension proximally, but the stalk of the T is overlapped by the subgenital plate and is not visible externally.

Three female specimens only, all from the Godman collection; one labeled "Cerro Zonil, 4–5000 ft., Champion"; the other two from Chiriqui.

Anacroneuria naomi new species.*

Length of fore wing 22 mm. ♀.

A large brownish species with yellow prothorax and banded legs. Head brownish, darkest in the middle, with pale M-mark in front and pale vertical tubercles that are transversely elongated and twice as long as wide. Lappets overlying the bases of the antennae blackish; the area between them

* Named in honor of Mrs. Naomi George Argo, who helped us efficiently in the preparation of the dried specimens of the Godman collection for study.

at the front pale. Antennæ lacking except the two basal segments which are blackish. Palpi brown.

The prothoracic disc is one-half wider than long. It is wholly yellow, a little darkened toward the sides in a pair of broad diffuse, obscure, longitudinal streaks, between the pale yellow of the middle area and the lateral margins. Wings (Fig. 6A) tawny, subhyaline, with somewhat darker veins, and a more yellowish tint on the coastal margin. Legs of the last pair (these only present) bright yellow basally, black beyond the second third of the femur.

Abdomen brownish, yellowish beneath. Tails brownish, densely clothed with short spinules. Subgenital plate of female truncate, acutely notched in the middle, with a mere suggestion of a second notch each side. The ninth sternite has a median area beset with stiff convergent spinules (Fig. 6).

Described from a single female of the Godman collection bearing the label "Senahu, Vera Paz, Champion." The legs are like those of *A. aethiops,* and we at first thought it might be a defectively colored specimen of that species, but the shape of prothorax is different, that of *A. aethiops* being twice as wide as long, and the subgenital plate and ninth sternite of the female are narrower.

Anacroneuria aethiops Walker

1852. *Perla aethiops* Walker. Catalog. B. M., p. 154.

1861. *Perla aethiops* Hagen. Synops. Neur. N. A., p. 24.

Length of fore wing 18–20 mm. ♀.

This is a big black species with banded legs. Head above mostly blackish, darkest between the ocelli and on the lappets that overlie the base of the antennæ, but yellowish at the sides both before and behind the eye and along a narrow line bordering the eye internally. Antennæ and palpi black.

Prothorax black above, quadrangular, twice as wide as long. Wings blackish, subhyaline between the darker veins. Legs black and yellow, the colors sharply and squarely delimited. Coxa, trochanter and basal two-thirds of femora bright yellow; remainder black.

Abdomen blackish, tails blackish, a little paler at the very base. Subgenital plate of female shield-shaped, truncate, with a shallow middle emargination and a suggestion of two others at the sides. The spinulosa middle area of the ninth sternite is broadly shield-shaped and margined with spinules in a close set series.

Two females are in the Godman collection from Chiapas.

Anacroneuria blanda new species.

Length of fore wing 13 mm. ♀.

Color yellowish varied with brown. Head yellow, with a large dark brown quadrangular crown spot covering the ocelli, the sides of this spot emarginate as shown in figure 9. The lappets that overlie the base of the antennae and the side margins of the head behind the eyes also are brown. Antennae and maxillary palpi brown, somewhat paler at base; labial palpi yellowish.

Prothorax wider than long, broadest in front with sides convex and converging to rearward. Its disc bears a median yellow stripe and a pair of lateral brownish ones. Meso- and metathorax pale dorsally except for a wash of brown beside the fore wing roots. Wings smoky hyaline with brown veins, becoming suffused with brown along veins Sc and R in the fore wing and along the stigma in both wings. In front of this the costa is yellowish. Legs yellow and brown, the yellow restricted to the basal half of the femora and the middle of the tibiæ, and being more extensive on hind than on fore legs.

Abdomen and tails yellow, the latter soft pilose. Subgenital plate of female, divided by an acute notch into two broadly rounded lobes and followed by spinulose tracts on both the ninth and tenth sternites (Fig. 9A).

TYPE, a single female specimen collected by Dr. W. C. Allee on Barro Colorado Island, Gatun Lake, Panama.

Anacroneuria coronata new species.

Length of fore wing 10 mm. ♂.

A small blackish brown species with iridescent wings and a large yellow crown spot covering most of the head. Antennæ and palpi brown. Head brown only at sides and rear, this color behind just touching and not enveloping the ocelli.

Prothorax brown with a yellow median band. The sides of the disc are parallel half way and then strongly convergent to the head margin. The wings are wholly brown, shining and iridescent, with black veins (Fig. 7A). In the expanded anal area of the hind wings the cells are fenestrate by reason of a more hyaline central area in each, whose breadth is about equal to that of the darker membrane bordering the veins. Legs all brown beyond the trochanter.

Abdomen brown: tails yellow. The prolonged ninth sternite of the male bears beneath a distinct nipple-shaped percussion disc or hammer (Fig. 7).

TYPE, a single male in the Cornell University collection bearing the label "Mexico, Sallee."

This is allied to the *Perla morio* Pictet from Colombia.

Anacroneuria dilaticollis Burmeister.

1839. *Perla dilaticollis* Burm. Handb. Ent. 2: 880.

1842. *Perla dilaticollis* Pict. Perlides, p. 240, pl. 23, fig. 5–10.

1852. *Perla dilaticollis* Walk. Catalog. B. M., p. 158.
1861. *Perla dilaticollis* Hagen. Synops. Neur. N. A., p. 25.

Length of fore wing, ♂ 7 to 10 mm.; ♀ 11 to 13 mm.

A small yellowish brown species that is very variable both in size and coloration. The head is brown, except for a pair of yellow lines that extend between the ocelli and the eyes. Antennæ brown including the basal aspect. Palpi brown.

Prothorax broad, narrower to rearward, its disc brownish with a median longitudinal yellowish band, and sometimes with touches of yellow upon the middle of the side margins. Wings tawny, subhyaline, with brown veins. Legs yellow with blackish knee caps and a brownish wash externally covering tarsi, tibiæ (except in the middle), and the apical third of the femora.

Abdomen brownish. Tails pale yellowish brown. The ninth ventral segment of the male is similar in form to that of the other known males of this genus, but it entirely lacks the ventral percussion disc or hammer. Our figure (Fig. 8) shows the extended penis and one of its pair of tenacula more enlarged. The tips of the genital hooks formed by the up-curving genital plates are obtusely pointed (Fig. 8A). The subgenital plate of the female is squarely truncated, with a small notch in the middle of its apical margin (Fig. 8B).

We have specimens of this species from Rio Santa Ana, British Honduras, collected by Karl P. Schmidt, and there are numerous specimens of both sexes in the Godman collection from localities as follows:

Guatemala
- Guatemala City, 2 ♀s
- San Geronimo, ♂ and ♀
- Zapote, 3 ♀s

Brazil
- Chapada, ♂

Mexico
- Atoyae, ♀
- Pancina, ♂
- Teapa, ♂ and ♀
- San Juan, Vera Paz, ♀

Country?
- V. de Chiriqui, 2 ♂s and 1 ♀ (Champion)
- El Zumbador, ♀ (Champion)

The obscure *Perla litura* of Pictet may possibly be a synonym of this species.

The nymph of Anacroneuria

We have no reared specimens of any species of this genus, but we have nymphs that undoubtedly belong to it from E. B. Williamson collected in Guatemala and from J. T. Lloyd, collected in Colombia. These have but two ocelli, and the venation of the developing wings shows the peculiar bending and pectinate branching of the second anal vein that is distinctive of the genus. We figure one of the Colombian nymphs herewith (Figs. 10A to E) and hereto add a brief description:

Length 9 to 14 mm.; antennæ 6½ to 10 mm., and tails 8 to 13 mm. additional.

Body depressed, rather smooth except for dense fringes of hairs along the tibiæ externally. Head trapezoidal, truncate in front, widest behind the eyes where there is a low transverse carina covering the hind angles. Antenna long, yellowish, composed of numberless close-set rings beyond the three enlarged basal segments; these rings become again longer toward the tip. Ocelli two, small, set squarely between the eyes. The mouth parts are as shown in Figs. 10B, C, D, and F.

Prothorax twice as wide as long, narrower to rearward, straightish on the front border, rounded on sides and at rear and on all angles. An obscure pattern of brownish lines on either side of the pale median area traverses the disc lengthwise. The remainder of thorax and abdomen is concolorous, pale brownish (perhaps, greenish in life). There is a transverse black dash across each femur just before the knee.

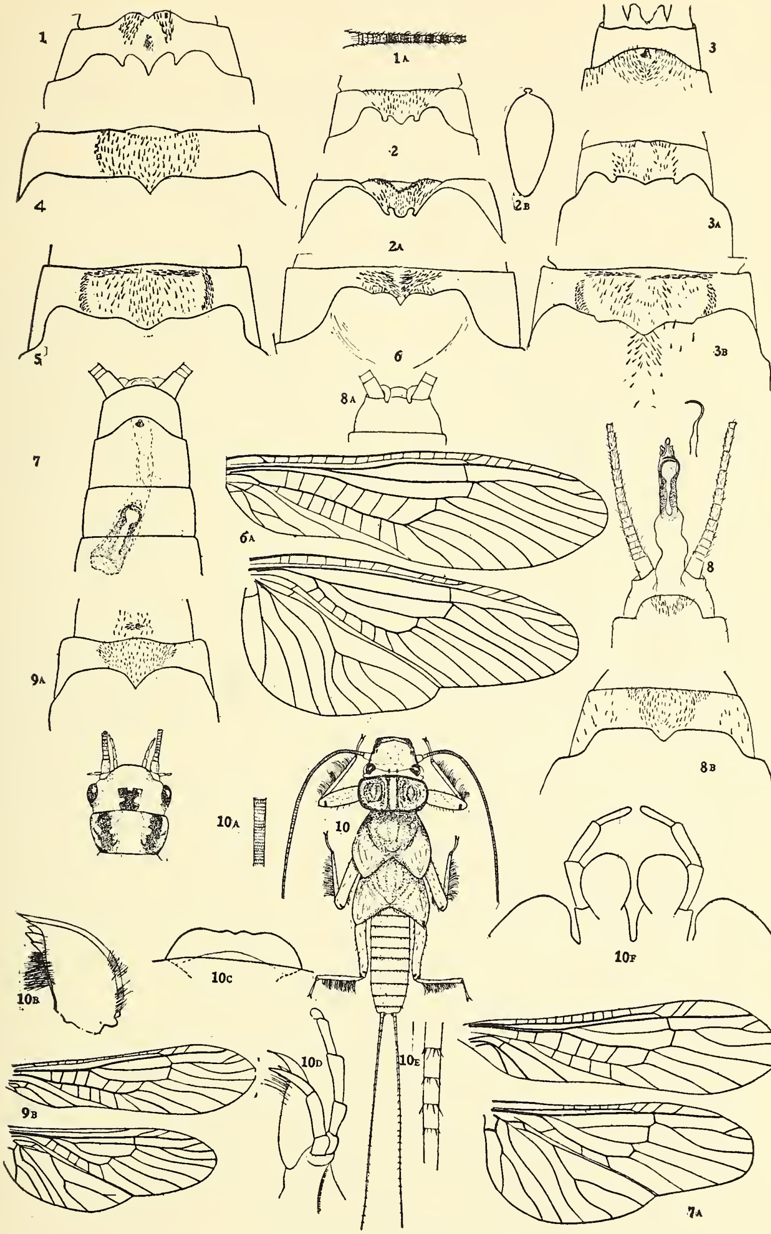
The yellowish tails are longer than the abdomen, their segments are longer than wide and each bears a circlet of stiff spinules around its apical border.

EGGS. We have examined the eggs of all the species of which we have had females, and with slight variations in size and taper, they conform to the type shown in our figure for *A. sulana* (Fig. 2B): all are oval with a low micropylar cap applied button-like to the broader end.*

* An Anacroneuria egg figure accidentally slipped into plate 6 (figure 10) of Needham & Claassen's "Monograph of the Plecoptera of North America." An undeterminable fragment of a single specimen of some member of this genus has since been found among some material from Texas, so that this genus should probably be added to the United States fauna.

EXPLANATIONS OF PLATE XII

Fig. 1. *A. annulicauda,* ♀ from Rio, Brazil; eighth and ninth segments, ventral view.
Fig. 1A. *A. annulicauda,* tail.
Fig. 2. *A. sulana,* ♀ from Rio Santa Ana, Honduras.
Fig. 2A. *A. sulana,* ♀ from Paso del Macho.
Fig. 2B. *A. sulana,* egg.
Fig. 3. *A. nigrocincta,* ♂ ventral view of end of abdomen.
Fig. 3A. *A. nigrocincta,* ♀ from Chapada.
Fig. 3B. *A. nigrocincta,* ♀ from Zapote.
Fig. 4. *A. cincta,* ♀ from Val. de Chiriqui.
Fig. 5. *A. aethiops,* ♀ from Chiapas, Mexico.
Fig. 6. *A. naomi,* ♀ from Senahu, Vera Paz.
Fig. 6A. *A. naomi,* wings.
Fig. 7. *A. coronata,* ♂ from Mexico; ventral view with penis indrawn.
Fig. 7A. *A. coronata,* wings.
Fig. 8. *A. dilaticollis,* ♂ ventral view with penis extruded and tenaculum detached.
Fig. 8A. *A. dilaticollis,* ♂ dorsal view showing genital hooks.
Fig. 8B. *A. dilaticollis,* ♀ from Val. de Chiriqui.
Fig. 9. *A. blanda,* ♀, head and prothorax; from Barro Colorado Island.
Fig. 9A. *A. blanda,* sub-genital plate of ♀.
Fig. 9B. *A. blanda,* wings.
Fig. 10. *Anacroneuria sp.,* nymph from Colombia.
Fig. 10A. *Anacroneuria sp.,* antenna.
Fig. 10B. *Anacroneuria sp.,* mandible.
Fig. 10C. *Anacroneuria sp.,* labrum.
Fig. 10D. *Anacroneuria sp.,* maxilla.
Fig. 10E. *Anacroneuria sp.,* tail.
Fig. 10F. *Anacroneuria sp.,* labium.



ANACRONEURIA

NEW THYSANOPTERA FROM THE UNITED STATES*

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The types of the new species described in this paper are in the author's collection.

Æolothrips vehemens new species. (Pl. XIII, Fig. 2.)

Female (*macropterous*).—Length about 1.6 mm. Color dark blackish brown (nearly black) with red subhypodermal pigmentation in thorax and abdomen; tarsi little, if any, paler than remainder of legs; antennæ dark blackish brown, with apex of segment 2 and all of 3 except tip, pale grayish yellow; *fore wings white in basal fourth* (except for a slight brownish cloud at extreme base) and at tip, and with a white transverse band just beyond middle, the remainder of wing dark brown.

Head broad, about 0.8 as long as greatest width, somewhat narrower across posterior portion of eyes than at base, equal in length to median line of pronotum, with faint anastomosing lines at sides and posteriorly, and with the usual minute bristles; anterior border not deeply emarginate by a forward prolongation of the eyes and without median tubercle, but evenly declivous and somewhat rugose transversely; cheeks very full, decidedly arched. Eyes about 0.44 as long as head, ventral portion prolonged posteriorly, that of left eye no farther from posterior margin of head capsule than width of third segment of antenna. Ocelli of posterior pair farther apart than their distance from anterior ocellus. *Antennæ about 2.5 times as long as head and only twice as long as its width; segment 5 about four times as long as segment 6, the sense cone on its ventral surface attached at its base only, the pale spot thus formed nearly circular.* Maxillary palpi three-segmented; labial palpi four-segmented.

Prothorax along median line of pronotum about 0.75 as long as greatest width, about 1.1 times as broad as head, not widened posteriorly. Pterothorax nearly 1.4 times as broad as prothorax, of the usual form; mesoscutum with the usual transverse anastomosing lines and the metascutum with the usual subreticulation. *Wings of fore pair long and broad, about 6.4 times as long as width at middle;* venation normal.

Abdomen of normal structure; tergite 1 not closely transversely striate.

Measurements of paratype (♀): Length 1.62 mm.; head, length 0.172 mm., greatest width 0.214 mm., least width (at posterior angles of eyes)

* Contribution from the Entomological Laboratories of Cornell University.

0.194 mm.; eyes, length 0.076 mm., width 0.055 mm., interval 0.084 mm.; prothorax, length 0.173 mm., width across coxæ 0.230 mm.; pterothorax, width 0.315 mm.; fore wings, length 1.15 mm., width just beyond middle 0.180 mm.; abdomen, width 0.405 mm.; segment 9, length 0.142 mm., segment 10, length 0.104 mm.

Antennal segments:	1	2	3	4	5	6	7	8	9
Length (μ)	32	64	116	86	76	19	18	17	11
Width (μ)	40	32	28	28	28	22	18	14	7

Total length of antenna 0.44 mm.

Described from 2 females taken by Alexander Wetmore in the Chusca Mountains, New Mexico, July 1, 1918, on *Populus aurea* [Hood, No. 397].

This is another member of the *fasciatus* group and is closest, it would seem, to the species described below as *wetmorei.* The italicized characters should serve to distinguish it.

Æolothrips wetmorei new species. (Pl. XIII, Fig. 1.)

Female (*macropterous*).—Length about 1.5 mm. Color dark blackish brown (nearly black) with red subhypodermal pigmentation in thorax and abdomen; tarsi brown; antennæ with apex of segment 2 and all of 3 except tip, pale greyish yellow, remainder of antenna dark blackish brown; *fore wings white in basal third* (except for a slight brownish cloud at extreme base) and at tip, and with a white transverse band just beyond middle, the remainder of wing dark brown.

Head about 0.94 as long as wide, about as wide across eyes as at base, slightly shorter than median length of pronotum, faintly transversely striate with anastomosing lines (particularly on cheeks) and with the usual minute bristles; anterior border not deeply emarginate by a forward prolongation of the eyes and without median tubercle but evenly declivous and somewhat rugose transversely; cheeks only slightly arched. Eyes about 0.45 as long as head, ventral portion prolonged posteriorly, that of left eye no farther from posterior margin of head capsule than width of third segment of antenna. Ocelli of posterior pair farther apart than their distance from anterior ocellus. *Antennæ only 2.15 times as long as head and only twice as long as its width; segment 5 about 2.7 times as long as segment 6, the sense cone on its ventral surface attached at its base only, the pale spot thus formed nearly circular.* Maxillary palpi three-segmented; labial palpi four-segmented.

Prothorax along median line of pronotum about 0.8 as long as greatest width, 1.2 times as broad as head, not widened posteriorly. Pterothorax nearly 1.4 times as broad as prothorax, of the usual form; mesoscutum with the usual transverse anastomosing lines and metascutum with the usual subreticulation. Wings of fore pair hardly seven times as long as width at middle; venation normal.

Abdomen of normal structure; tergite 1 not closely transversely striate.

Measurements of holotype (♀): Length 1.49 mm.; head, length 0.170 mm., greatest width 0.180 mm., width across eyes 0.173 mm.; eyes, length 0.076 mm., width 0.047 mm., interval 0.078 mm.; prothorax, length 0.177 mm., width (inclusive of coxæ) 0.215 mm.; pterothorax, width 0.297 mm.; fore wings, length 0.825 mm., width at middle 0.120 mm.; abdomen, width 0.375 mm.; segment 8, length 0.090 mm.; segment 9, length 0.144 mm.; segment 10, length 0.113 mm.

Antennal segments:	1	2	3	4	5	6	7	8	9
Length (μ)	32	56	92	72	52	19	16	14	12
Width (μ)	36	27	24	23	24	21	18	12	7

Total length of antenna 0.37 mm.

Male (*macropterous*).—Similar to female in color and structure, but much smaller; abdomen with claspers at tip, but lacking chitinous prolongations on tergites 4–6.

Described from 10 females and 1 male taken by Alexander Wetmore at Williams, Arizona, July 8, 1918, on various plants [Hood, No. 398].

In wing pattern and general structure, *wetmorei* is allied to *fasciatus, nasturtii,* and the new species described in this paper as *vehemens;* but the long head, short antennæ, and the proportionate lengths of antennal segments 5 and 6 (all of which characters are emphasized by italics in the description above) serve abundantly for its recognition.

The species is named for Dr. Alexander Wetmore, Assistant Secretary of the Smithsonian Institution, who has added many interesting species to the North American list of Thysanoptera.

Æolothrips oculatus new species. (Pl. XIII, Fig. 3.)

Female (*macropterous*).—Length about 1.5 mm. Color blackish brown, with a decided reddish cast, due to an almost continuous layer of red subhypodermal pigmentation in the thorax, abdomen, and femora; tarsi pale, the fore pair in basal half and the tips of fore tibiæ lemon yellow; antennæ with segments 1 and 2 concolorous with head, apex of 2 paler; segments 3 and 4 grayish yellow, the former shading to brown at extreme apex and with pedicel brown, the latter with its brief pedicel likewise brown and shading to brown in apical half or three-fifths; 5–9 nearly uniform grayish brown; *fore wings with a dark transverse band occupying the middle fifth, this band involving the ambient vein in front and widened posteriorly; distal two-fifths of wing darkened in a little less than posterior half, proximal two-fifths brown along ambient vein and in scale.*

Head nearly 1.1 times as long as greatest width, nearly 1.5 times as long as pronotum along median line, surface almost without sculpture except at

sides, with the usual minute bristles on occiput and cheeks; anterior border not deeply emarginate by a forward prolongation of the eyes and without median tubercle, but somewhat depressed, evenly declivous, and somewhat rugose transversely; cheeks only slightly arched. Eyes about 0.4 as long as head, *ventral portion only slightly prolonged posteriorly, their posterior angles averaging about as far from labrum as width of eye. Ocelli nearly equidistant.* Antennæ about 1.9 times as long as head; *sense cone on ventral surface of segment 5 attached for half its length, the usual pale spot being thus transformed into a pale line.* Maxillary palpi three-segmented.

Prothorax along median line of pronotum about 0.64 as long as greatest width, relatively little broader than head, not widened posteriorly. Pterothorax more than 1.4 times as broad as prothorax, of the usual form; mesoscutum with transverse anastomosing lines, these not closely spaced; metascutum faintly subreticulate. Wings of fore pair a little more than seven times as long as width at middle; venation normal. Legs rather short.

Abdomen of normal structure; tergite 1 not closely transversely striate.

Measurements of holotype (♀): Length 1.53 mm.; head, length 0.202 mm., greatest width 0.186 mm., least width (at base) 0.174 mm.; eyes, length 0.083 mm., width 0.058 mm., interval 0.070 mm.; prothorax, length of pronotum 0.136 mm., width across coxæ 0.212 mm.; pterothorax, width 0.311 mm.; fore wings, length 0.810 mm., width at middle 0.114 mm.; abdomen, greatest width 0.414 mm.; length of segment 8, 0.100 mm., of segment 9, 0.156 mm., of segment 10, 0.104 mm.

Antennal segments:	1	2	3	4	5	6	7	8	9
Length (μ)	36	56	85	77	62	24	17	17	14
Width (μ)	37	29	24	25	25	21	17	12	7

Total length of antenna 0.39 mm.

Described from one female taken at Boulder, Colorado (Gregory Canon), June 21, 1924, in flowers of *Pinus scopulorum*, by L. O. Jackson.

This species may readily be known by the italicized characters in the above description. It is closest to *vittipennis*, *crassus*, *vittatus*, and *mexicanus*.

Chirothrips productus new species. (Pl. XIV, Fig. 3.)

Female (*macropterous*).—Length about 1.25 mm. Color dark brown, thorax tinged with orange subhypodermal pigmentation; tarsi, apex of fore tibia and of second antennal segment, and most of segment 3, yellowish; ocellar pigment red; fore wings brown, paler just beyond base, veins darkest; hind wings slightly darkened basally and along median line, remainder clear.

Head 1.0 to 1.18 times as long as wide and 0.6 to 0.67 as long as prothorax, somewhat broadest across eyes, occiput with about three anastomosing lines; cheeks straight and parallel, a little less than one-fifth as long

as head and about one-third as long as eyes (0.32 to 0.39); *head distinctly produced in front of eyes, the distance from anterior margin of eyes to base of antennæ about one-half the length of cheeks, and to front of head about 1.5 times the length of cheeks; front rather broad, the interval between antennæ about one-third the width of segment 1;* three to five pairs of minute bristles near base of antennæ, in addition to a somewhat longer and stronger pair situated *slightly* in front of anterior ocellus and close to eyes. Eyes 0.5 to 0.55 as long as head and about 0.64 as wide as their interval. Ocelli subequal, the posterior pair slightly more widely separated and opposite posterior margin of eyes. Antennæ about 1.8 times as long as head; segment 1 decidedly shorter than segment 2; the latter not shoe-shaped, wider than long, with outer angle distinctly produced, but without sense cone on extreme apex.

Prothorax about 1.2 times as wide as long, sides almost perfectly straight; pronotum with the usual scattered, minute bristles and with the anastomosing striæ rather heavy and prominent, more or less broken up into dark scallops; the two pairs of bristles at posterior angles moderately long, dark. Pterothorax nearly 1.2 times as wide as prothorax; mesoscutum with anastomosing striæ throughout or with a few at posterior margin broken up into scallops. Wings of fore pair about 15 times as long as width at middle, slightly curved; costa, anterior vein and posterior vein with about 18, 9, and 4 bristles, respectively.

Abdomen broader than pterothorax, with transverse anastomosing striæ above and below; tergites with posterior margins dentate, striæ on tergite 1 not broken up into scallops; chitinous line near base of tergite 2 not interrupted; *sternites 2–6 without rounded teeth across middle of posterior margin, but with one or more transverse rows of scallops in front of posterior margin, particularly on sternite 2, which has four or five such rows. Segment 10 about 1.4 times as long as basal width, noticeably slender and acute,* divided above.

Measurements, principally of paratype from Aurora, Colo. (♀): Length 1.25 mm.; head, length .122 mm., greatest width 0.110 mm., length in front of eyes 0.036 mm., length of cheeks 0.024 mm.; eyes, length 0.062 mm., width 0.036 mm., interval 0.056 mm.; prothorax, length 0.206 mm., width 0.252 mm.; pterothorax, width 0.288 mm.; fore wings, length 0.825 mm., width at middle 0.054 mm., near base 0.076 mm.; abdomen, width 0.300 mm.; segment 10, length 0.102 mm., width at base 0.072 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	32	32	31	48	36	10	12
Width (μ)	34	38	23	24	20	18	7	5

Total length of antenna 0.22 mm.

Described from 5 females, as listed below:

North Dakota: Devils Lake, May 4, 1916, on *Achillea lanulosa*, James Silver, Jr.; 1 ♀ (*holotype*) [Hood, No. 131].

Colorado: Aurora, June 22, 1918, sweepings, L. O. Jackson; 1 ♀ [Hood, No. 514].

Denver, June 21, 1918, sweepings, L. O. Jackson; 2 ♀ [Hood, No. 511].

Utah: Mouth of Bear River, June 6, 1915, sweepings, A. Wetmore; 1 ♀ [Hood, No. 13].

This is another member of the *manicatus* group. The italicized characters should serve for its recognition. The produced head, acute abdomen, and the structure of the abdominal sternites are quite distinctive.

Chirothrips simplex new species.* (Pl. XIV, Fig. 4.)

Female (macropterous).—Length about 1.2 mm. Color quite uniform dark blackish brown, thorax tinged with orange subhypodermal pigmentation; tarsi and third antennal segment usually yellowish; ocellar pigment maroon red; fore wings blackish brown, paler just beyond base, veins darkest; hind wings slightly darkened basally and along median line, remainder clear.

Head slightly longer than wide and 0.6 as long as prothorax, somewhat broadest across eyes, occiput with three or four anastomosing lines; cheeks straight and parallel, about one-fifth as long as head and slightly more than one-third as long as eyes; head very little, if at all, elongated between eyes and antennæ, the distance from anterior margin of eyes to front of head about equal to length of cheeks; front rather broad, *the interval between antennæ one-third the width of segment 1;* two pairs of minute bristles near base of antennæ, in addition to *a particularly long and prominent pair situated close to eyes and far in front of anterior ocellus.* Eyes about 0.6 as long as head and about 0.6 as wide as their interval. Ocelli subequal, the posterior pair slightly more widely separated and opposite posterior margin of eyes. Antennæ about 1.8 times as long as head, nearly uniform blackish brown, apex of 2 and all of 3 usually paler and yellowish, pedicel of latter nearly colorless; segment 1 decidedly narrow, shorter than segment 2, the latter as long as greatest width, with sides rounded and *outer apical angle not prolonged, broadly and evenly rounded instead,* without sense-cone on outer surface of apex; 3 about 1.3 times as long as greatest width, with slender pedicel; 4 and 5 longer than wide, very briefly pedicellate; 6 nearly twice as long as wide, broadest at basal two-fifths, sides rounded; 7 and 8 short, about equal in length, 8 about twice as long as wide.

Prothorax narrow, about 1.23 times as wide as long, sides almost perfectly straight; pronotum with a few scattered, minute bristles (about comparable with those near base of antennæ), and with *the anastomosing striæ un-*

* It is not unlikely that this species is Priesner's *Chirothrips falsus* (Zool. Jahrb., Bd. 50, p. 312; March, 1925), but his brief description, unaccompanied by figures, makes accurate identification impossible.

usually heavy and prominent, more or less broken up into dark scallops; the two pairs of bristles at posterior angles short, stout, dark, and prominent Pterothorax 1.2 times as wide as prothorax; mesoscutum with anastomosing striæ throughout or with a few at posterior margin broken up into scallops. Wings of fore pair about 18 times as long as width at middle, curved slightly throughout their length; costa, anterior vein, and posterior vein with about 15, 8, and 4 bristles, respectively.

Abdomen broader than pterothorax, with transverse anastomosing striæ above and below; tergites with posterior margins dentate, striæ on tergite 1 not broken up into scallops; chitinous line near base of tergite 2 not interrupted; sternites with striæ finer and more widely spaced, otherwise similar to those on tergites; *sternite 2 with rounded teeth on posterior margin,* the series sometimes interrupted and irregular between median pair of bristles, continuous elsewhere. Segment 10 about 1.2 times as long as basal width, pointed at apex, divided above.

Measurements of paratype (♀): Length 1.22 mm.; head, length 0.110 mm., width across eyes 0.105 mm., length in front of eyes 0.021 mm.; cheeks, length 0.023 mm.; eyes, length 0.064 mm., width 0.028 mm., interval 0.047 mm.; prothorax, length 0.183 mm., width 0.225 mm.; pterothorax, width 0.270 mm.; fore wings, length 0.855 mm., width just beyond scale 0.085 mm., at middle 0.047 mm.; abdomen, width 0.300 mm.; segment 10, length 0.093 mm., width at base 0.078 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	20	30	30	30	24	35	9	10
Width (μ)	29	29	23	25	22	18	6	5

Total length of antenna 0.19 mm.

Described from 27 females, collected as follows:

Colorado: Denver, May 17, 1919, on *Leucocrinum montanum,* L. O. Jackson; 1 ♀ (*holotype*); No. 517.

Denver, May 2, 1919, sweepings, L. O. Jackson; 14 ♀; No. 519.

Grant, July 21, 1916, sweepings, L. O. Jackson; 1 ♀; No. 345.

Boulder (Flagstaff Mt.), June 28, 1924, L. O. Jackson; 3 ♀.

Nebraska: Lincoln, Oct. 9, 1893, on *Boutelona oligostachya,* H. G. Barber; 6 ♀.

Illinois: Havana, Aug. 8, 1908, sweeping grass, C. A. Hart; 2 ♀.

At first glance this species is suggestive of *C. manicatus* (Haliday), but is readily known by the more slender body; the narrower head, with the pair of prominent bristles in front of the

anterior ocellus near the eyes and the wide frontal costa; the relative lengths and widths of the first and second antennal segments and the form of the latter segment; and the long prothorax, with its heavy sculpture.

Chirothrips crenulatus new species. (Pl. XIV, Fig. 2.)

Female (*macropterous*).—Length about 1.1 mm. Color of head, thorax, legs, and antennæ, brown, except tarsi and apex of second antennal segment, which are yellow; pterothorax with reddish orange subhypodermal pigmentation; *abdomen reddish orange, decidedly paler than rest of body,* segment 9 at apex and all of 10 much darkened with black; fore wings brown, paler just beyond base, veins darkest; hind wings slightly darkened basally and along median line, remainder clear.

Head slightly longer than wide and 0.6 as long as prothorax, somewhat broadest across eyes, occiput smooth; cheeks straight and parallel, about one-sixth as long as head and one-third as long as eyes; *head distinctly produced in front of eyes, the distance from anterior margin of eyes to base of antennæ about one-half the length of cheeks, head in front of eyes about twice the length of cheeks;* interval between antennæ less than one-fourth the width of segment 1; *five or six pairs of stout, prominent bristles in front of ocellar triangle, the posterior pair opposite anterior ocellus.* Eyes half as long as head and 0.6 as wide as their interval. Ocelli subequal, the posterior pair distinctly more widely separated and opposite posterior margin of eyes. Antennæ about 1.7 times as long as head; segment 1 enlarged and swollen, about as long as 2 and with a distinct transverse carina; 2 inverted shoe-shaped, very much broader than long, with distinct sense cone on extreme apex of outer angle.

Prothorax about 1.33 times as wide as long, sides slightly concave anteriorly; *pronotum with the usual bristles stouter and more prominent than usual, surface smooth;* the two pairs of bristles at posterior angles short but distinct, brown. Pterothorax nearly 1.2 times as wide as prothorax; mesoscutum with a few separated scallop-like thickenings near cephalic margin; metascutum subreticulate, the posterior reticles with their mediad sides thickened; ventral surface with numerous stout bristles comparable with those on head; wings of fore pair about 17 times as long as width at middle, usually slightly curved; costa, anterior vein, and posterior vein with about 14, 8, and 4 bristles, respectively.

Abdomen broader than pterothorax, surface nearly smooth; *chitinous line near base of tergites broken up into numerous very minute scallops, there being nearly thirty on tergite 2;* sternite 1 with several transverse rows of scallops; segment 10 less than 1.2 times as long as basal width, not very sharply conical, divided above.

Measurements of holotype (♀): Length 1.13 mm.; head, length 0.112 mm., greatest width 0.107 mm., length in front of eyes 0.040 mm., length of cheeks 0.018 mm.; eyes, length 0.055 mm., width 0.028 mm., interval 0.048

mm.; prothorax, length 0.185 mm., width 0.246 mm.; pterothorax, width 0.287 mm.; fore wings, length 0.780 mm., width at middle 0.046 mm., at base 0.076 mm.; abdomen, width 0.309 mm.; segment 10, length 0.080 mm., width at base 0.069.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	26	27	30	30	22	34	9	9
Width (μ)	45	41	26	28	22	18	6	4

Total length of antenna 0.19 mm.

Described from four females, as listed below:

Colorado: Boulder (Flagstaff Mt.), June 28, 1924, L. O. Jackson; 1 ♀ (*holotype*).

Denver, June 21, 1918, sweeping, L. O. Jackson; 1 ♀.

"Colorado," 1916, sweeping, L. O. Jackson; 1 ♀.

Nebraska: Lincoln, July 1, 1890, in room, Lawrence Bruner; 1 ♀.

Very close to *C. mexicanus,* but readily known by the characters italicized above.

Sericothrips pedicellatus new species. (Pl. XIV, Fig. 1.)

Female (macropterous).—Length about 1.0 mm. Color straw-yellow, with numerous brown markings; ocellar pigment bright red; prothoracic blotch not evident; pterothorax with a few obscure brown markings, of which a large pair on metascutum are most distinct; abdominal tergites 2–7 each with a narrow, transverse, nearly black line at base, margined behind with a brown band which occupies the basal half of tergites 2 and 7, and the basal fourth of 3–6; antennæ with segment 1 nearly colorless; 2 yellowish, lightly shaded with brownish; 3 paler than 2, nearly concolorous with 1, apex not darker; 4 blackish brown, paler apically and much paler basally; 5–8 blackish-brown, 5 slightly paler at base; legs concolorous with body, with coxæ distinctly, and femora very lightly, shaded with brown; fore wings lightly brownish, darkest just beyond the nearly white basal fifth, middle fifth paler, apical fifth nearly white; hind wings with the usual dark brown median streak.

Head of normal form, broadest across the eyes, surface distinctly and finely striate, particularly on occiput and on vertex, bristles as usual in the genus. Eyes prominent, protruding, pilose. *Antennæ decidedly slender, segment 3 being fully three times, segment 6 about 3.7 times, and segment 8 about 3.5 times, as long as wide; 1 unusually short, only slightly more than one-half as long as 2; 7 very briefly but distinctly pedicellate.* Mouth cone long, surpassing base of prosternum.

Prothorax of the usual form, and pronotum with the usual raised, anastomosing, transverse lines, which are somewhat more closely spaced just in front of and just behind the two major foveæ; bristle at posterior angles

colorless, a little more than one-third as long as pronotum. Forewings with about 22 bristles on costal margin and 3 + 16 on longitudinal vein; no additional bristles near tip of wing, in a series posterior to longitudinal vein. Legs not markedly long and slender.

Abdomen normal; pubescence not conspicuous, absent from median portion of basal tergites; bristles slender and colorless.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	20	36	55	46	45	52	10	14
Width (μ)	24	25	18	18	17	14	6	4

Total length of antenna, 0.28 mm.

Described from a unique female taken by the late Charles A. Hart at Makanda, Illinois, June 26, 1909, in sweepings from grass and weeds.

Structurally this is quite likely our most distinct American species, the pedicellate sixth antennal segment occurring nowhere else in the genus save in *gracilicornis* Williams, a quite different insect known only from England. The antennæ are remarkable, among the species described from north of the tropical life zone, for their slenderness.

Sericothrips variabilis (Beach).

1896. *Thrips variabilis* Beach, var. *d,* Proc. Iowa Acad. Sci., Vol. III, p. 220. Ames, Iowa, on smartweed and cucumber.

1902. *Sericothrips variabilis,* var. *d,* Hinds, Proc. U. S. Nat. Mus., Vol. XXVI, p. 143. Amherst, Mass., on grass.

Miss Beach described four varieties of her new species *Thrips variabilis,* and called them Vars. *a, b, c,* and *d.* I have seen and studied her types of varieties *a, b,* and *d.* The types of *c* are apparently missing, though there is in the lot a slide labeled "*Thrips variabilis* Beach. Var. *c.* ♂ and ♀ types. On cucumber, Ames, Iowa, July 28, 1894" bearing Hinds' label "*Sericothrips variabilis* (Beach). W. E. Hinds, Amherst, Mass., 1902." The specimens, however, as Dr. Hinds has previously noted,* fit her description of Var. *d,* instead of *c*; and, furthermore, the host plant (cucumber) and the date (July 28—1893 in the description, 1894 on the slide) correspond with those given for part of the material covered by her description of Var. *d,* and not at all with those for Var. *c.*

As it is almost certain that Miss Beach's so-called varieties represent distinct species, it is necessary to designate a single

* L. c., p. 145, footnote.

selected specimen of ultimate reference; and as Var. *d* is an easily recognized form, common and well distributed in Eastern United States, while the other varieties are rarer and not so easily recognized, I have preferred to associate the name *variabilis* with the specimens studied by Hinds, and have accordingly labeled the female and male types of Miss Beach's Var. *d* as the holotype and allotype, respectively, of the species.

Sericothrips variabilis (Beach), as at present restricted, is a dark colored species in which the abdomen is entirely bare of pubescence along the median dorsal line; the seventh to tenth segments of the abdomen dark blackish brown and abruptly darker than segment 6; the fore wings with three white bands, the first just beyond base, the second at middle, and the third at tip, and with two bristles near tip forming an additional series behind the longitudinal vein; the antennæ with segments 1 and 2 darker than 3; and the pronotal blotch *very* closely and finely transversely striate, the pronotum in front of the blotch with striæ which are much farther apart but which do not tend toward subreticulation.

The following material has been studied:

Iowa: Ames, July 28, 1894, on cucumber; 1 ♀, 1 ♂ (*holotype* and *allotype*, herein designated).

Illinois: Carbondale, June 14, 1907, sweeping, J. D. Hood; 1 ♀, 1 ♂.

Havana, Aug. 9, 1908, from willow, C. A. Hart; 3 ♀.

Muncie, May 16, 1909, from crabapple and in sweepings, C. A. Hart; 1 ♀, 1 ♂.

Pulaski, May 29, 1909, sweeping, C. A. Hart; 2 ♀, 2 ♂.

Maryland: Plummer's Island, April 20, 1913, on *Viburnum,* W. L. McAtee and J. D. Hood; 1 ♀.

Virginia: Tazewell, June 10, 1915, L. O. Jackson; 1 ♀.

Sericothrips beachæ new species.

Female (*macropterous*).—Length about 0.8 mm. Color straw-yellow with numerous brown markings; prothoracic blotch not distinct, broken up into three transverse spots on either side, the anterior pair of spots largest and connected; ocellar pigment red; mesoscutum brown along anterior margin and at sides, metascutum with a pair of large brown spots; *abdominal tergites 2–7 each with a narrow, transverse, nearly black line at base, behind*

which, at each end, is a large, transverse brown spot; antennæ with segment 1 colorless; 2 brown, darkest at sides; 3 light grayish yellow, much paler than 2, apical third or fourth darkened, especially at sides; 4 light grayish yellow in basal half, dark grayish brown beyond; *5 pale brownish yellow in basal half, dark grayish brown in apical half,* which is concolorous with 6–8; legs very pale yellow, with femora lightly shaded with brown on outer surface apically; fore wings with a gray cloud in third ninth, nearly white just basally to it, slightly grayish again at base, remainder of wing very light gray, paler at middle and at apex; color by reflected light yellow, with evident subhypodermal pigmentation in head and thorax, the brown markings more distinct, especially the pronotal blotch, ocellar pigment orange red.

Head broad, widest across eyes, cheeks straight and parallel, surface nearly free of sculpture, bristles as usual in the genus. Eyes prominent, protruding, pilose, about 0.63 as wide as their interval, which is very slightly greater than their length. Antennæ of the usual form, sixth segment not pedicellate. Mouth cone slightly surpassing posterior margin of prosternum.

Prothorax with the pronotum nearly 1.5 times as wide as long, of the usual form, the *transverse anastomosing lines not closely spaced within the area of the pronotal blotch and hardly more widely spaced outside it;* bristle at posterior angles pale gray, nearly half the median length of pronotum. Fore wings nearly twenty times as long as width at middle, which is about 0.52 the width just beyond scale; costal margin with about 24 bristles, longitudinal vein with 3 + 19, the distal one of these somewhat widely separated from the others; *two additional bristles near tip of wing, in a series posterior to longitudinal vein.* Legs not markedly long and slender.

Abdomen normal; pubescence distinct, dark, absent from median portion of basal tergites; bristles slender, yellowish, inconspicuous.

Measurements of holotype (♀): Length 0.813 mm.; head, length 0.084 mm., greatest width (across eyes) 0.139 mm., least width (at base) 0.130 mm.; eyes, length 0.058 mm., width 0.039 mm., interval 0.062 mm.; prothorax, median length of pronotum 0.120 mm., width 0.174 mm.; pterothorax, width 0.210 mm.; fore wings, length 0.668 mm., width at middle 0.034 mm., near base 0.065 mm.; abdomen, width 0.236 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	20	36	47	44	38	46	10	13
Width (μ)	25	26	21	20	18	16	7	5

Total length of antenna 0.25 mm.

Described from 16 females and 5 males, taken in catkins of the common hop, White Heath, Illinois, October 13, 1907, J. D. Hood. Named after Miss Alice M. Beach, the author of one of our earliest papers on North American Thysanoptera.

This is the species which I have for years considered *Sericothrips variabilis,* and of which I have distributed numerous specimens to the collections of Bagnall, Buffa, Crawford, Karny,

Schille, and others. It was excessively abundant at the time, and thousands of specimens might well have been taken. I have not seen it since.

The italicized characters define the species readily. It resembles in many ways *annulipes* (which has abdominal segments 7 and 8 blackish brown), *interruptus* (which has only *one* bristle in an additional series behind the longitudinal vein of the fore wing), and *apicalis* (which has no such additional wing bristles).

Sericothrips setosus new species.

Female (*macropterous*).—Length about 1.1 mm. Color orange-yellow, deepest in pterothorax, marked with brown blotches; ocellar pigment red; prothoracic blotch not evident, usually represented by a narrow, transverse brown line outlining its anterior margin, and a pair of rounded blotches (sometimes more or less broken up) behind; pterothorax with indistinct brown blotches, a moderately conspicuous pair on metascutum (best seen by reflected light) followed posteriorly by a pair of deep brown dashes;* abdominal tergites 2–7 each marked at base with a deep brown transverse line, behind which there is a brown band of varying width, usually broadest at sides; antennæ with segment 1 pale, remaining segments brown, nearly unicolorous, 2 sometimes darker and 3–5 indistinctly paler at middle; legs about concolorous with body, femora and tibiæ somewhat shaded with brown; fore wings very light brownish, indistinctly darker basally; hind wings with the usual dark median streak; *all bristles on body and appendages brown in color and quite conspicuous.*

Head about 1.8 times as broad as length in front of occipital line, widest across eyes, surface free of sculpture, bristles as usual in the genus. Eyes pilose, about 0.73 as wide as their interval, which is about equal to their length. Antennæ about 3.1 times the length of head in front of occipital line, segments formed as usual in the group, segment 6 not pedicellate. Mouth cone short, not nearly attaining base of prosternum.

Prothorax with the pronotum about 1.3 times as long as head in front of occipital line and 1.6 times as wide as long, of the usual form; pronotum with the usual raised, anastomosing, transverse lines very indistinct, not widely spaced outside the area usually occupied by the pronotal blotch nor very closely spaced within it; bristle at posterior angles dark brown and conspicuous. Fore wings about 20 times as long as width at middle, which is about 0.56 the width just beyond base; costal margin with about 25 bristles, longitudinal vein with about 3 + 17, of which the apical one is more widely separated than the others; one additional bristle near tip of wing, behind longitudinal vein. Legs normal, but *with conspicuous brown bristles.*

Abdomen normal; minute pubescence pale and almost invisible, even under the highest magnifications.

* These are internal and are probably apodemes.

Measurements of holotype (♀): Length 1.08 mm.; head, length to occipital line 0.084 mm., greatest width (across eyes) 0.152 mm., least width (at base) 0.134 mm.; eyes, length 0.064 mm., width 0.045 mm., interval 0.062 mm.; prothorax, median length of pronotum 0.113 mm., width 0.180 mm.; pterothorax, width 0.248 mm.; fore wings, length 0.720 mm., width at middle 0.036 mm., near base 0.064 mm.; abdomen, width 0.296 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	22	39	52	43	37	47	10	13
Width (μ)	24	27	18	18	17	16	7	5

Total length of antenna 0.26 mm.

Male (*macropterous*).—Length 0.85 mm. Very similar to female in most points of color and structure, but slenderer.

Described from ten females and one male, all taken by Bert R. Coad at Tucson, Arizona, April 24, 1914, on greasewood.

This species is no doubt closest to those which I have named *beachæ*, *interruptus*, and *apicalis*; but the coloration of the body and antennæ, and especially the conspicuous dark bristles on the body and its appendages, should serve for its ready recognition.

Sericothrips interruptus new species.

Female (*macropterous*).—Length about 1.0 mm. Color straw-yellow, tinged with orange in pterothorax, and with numerous brown markings; ocellar pigment red, ocellar area darkened with brown; prothoracic blotch hardly visible by transmitted light, broken up into several small connected spots; mesoscutum lightly and indistinctly marked with brown at sides and along anterior margin; metascutum with a pair of large, vague, brown spots; abdominal tergites 2–7 each with a narrow, transverse, nearly black line at base, which is *broadly interrupted in the median third or fourth of tergites 2 and 7, and somewhat less distinct at the middle of 3–6*, bordered behind at either side of tergite with a brown spot; antennæ with segment 1 pale; 2 and 3 gray, the former shaded laterally and the latter distally with brownish or gray; 4–8 gray brown, 4 paler near base and narrowly nearly black at apex; legs nearly concolorous with body, femora apically and tibiæ at middle, somewhat shaded with brown; fore wings nearly uniform light brown, paler apically; hind wings with the usual dark median streak.

Head about twice as broad across eyes as length to the faint occipital line, not narrowed just behind eyes, cheeks not rounded, surface free of sculpture, bristles as usual in the genus. Eyes scarcely protruding, pilose, about 0.7 as wide as their interval, which is about equal to their length. Antennæ about 3.4 times as long as head in front of occipital line, segments formed as usual in the group, sixth not pedicellate. Mouth cone about attaining base of prosternum.

Prothorax with the pronotum about 1.5 times as long as head in front of occipital line and fully 1.5 times as wide as long, of the usual form; pronotum with the usual raised anastomosing transverse lines, which are about

equally spaced within and without the pronotal blotch; *bristle at posterior angles grayish, short, hardly one-third the length of pronotum.* Fore wings about 21 times as long as width at middle, which is about 0.53 the width just beyond base; costal margin with about 25 bristles, longitudinal vein with 3 + 20; *one additional bristle near tip of wing, behind longitudinal vein.* Legs normal, bristles barely visible.

Abdomen normal; pubescence distinct, especially in the brown spots, absent in median portion of basal tergites; bristles slender, pale, inconspicuous.

Measurements of holotype (♀): Length 0.97 mm.; head, length to occipital line 0.076 mm., greatest width (across eyes) 0.156 mm., least width (at base) 0.144 mm.; eyes, length 0.062 mm., width 0.045 mm., interval 0.065 mm.; prothorax, median length of pronotum 0.116 mm., width 0.182 mm.; pterothorax, width 0.245 mm.; fore wings, length 0.720 mm., width at middle 0.034 mm., width near base 0.064 mm.; abdomen, width 0.266 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	34	45	41	38	48	10	15
Width (μ)	25	26	19	18	18	16	7	5

Total length of antenna 0.26 mm.

Male (*macropterous*).—Length about 0.78 mm. Very similar to female in color and structure.

Described from two females taken by R. C. Shannon near Plummer's Island, Maryland, Jan. 10, 1915, hibernating in bird's nest; and from one male taken by the writer on Plummer's Island, Maryland, Oct. 5, 1913, on red oak.

The pale color, nearly uniform brownish wings, and the characters italicized in the above description should serve for the recognition of the species. It belongs near *setosus*.

Sericothrips apicalis new species.

Female (*macropterous*).—Length about 1.1 mm. Color uniform straw-yellow, with numerous brown markings; ocellar pigment red; prothoracic blotch broken up into several brown spots which are usually more or less connected, the concave front margin of the blotch well defined, particularly as seen by reflected light; mesoscutum brown along anterior margin and metascutum with a pair of large brown spots; abdominal tergites 2–7 each with a narrow, transverse, nearly black line at base, behind which, at each end, is a brown spot; antennæ with segment 1 nearly colorless; 2 yellowish, darkened with brown; 3 grayish yellow, extreme apex dark blackish brown; 4 grayish yellow in basal half, gray-brown beyond, apex dark blackish brown; 5 blackish brown in distal half and in pedicel, intervening portion yellowish gray; 6–8 blackish brown; legs concolorous with body, very lightly, if at all, shaded with brown; fore wings pale yellowish (nearly white), with a small, faint brownish spot beyond scale and another near base, opposite scale; hind wings with the usual dark median streak.

Head broad, about 1.7 times as wide as length in front of occipital line, broadest across eyes, surface nearly free of sculpture, bristles as usual in the genus. Eyes prominent, protruding, pilose, two-thirds as wide as their interval, which is about equal to their length. Antennæ about 3.3 times as long as head in front of occipital line, segments formed as usual in the group, sixth not pedicellate. Mouth cone about attaining base of prosternum.

Prothorax with the pronotum about 1.5 times as long as head in front of occipital line and nearly 1.5 times as wide as long, of the usual form; pronotum with the usual raised, anastomosing, transverse lines, which are very closely spaced in the area of the pronotal blotch and *only slightly more widely spaced outside it;* bristle at posterior angles grayish, short, about 0.4 as long as pronotum. Fore wings about 20 times as long as width at middle, which is about 0.53 the width just beyond base; costal margin with about 25 bristles, longitudinal vein with a basal group of 3 followed by about 19, the distal one of these somewhat widely separated from the others; *no additional bristles near tip of wing, in a series posterior to longitudinal vein.* Legs not markedly long and slender.

Abdomen normal; pubescence pale and indistinct, absent from median portion of basal tergites; bristles slender, yellowish, inconspicuous.

Measurements, principally of holotype (♀): Length 1.07 mm.; head, length to occipital line 0.088 mm., greatest width (across eyes) 0.154 mm., least width (at base) 0.130 mm.; eyes, length 0.063 mm., width 0.044 mm., interval 0.066 mm.; prothorax, length of pronotum along median line 0.130 mm., width 0.190 mm.; pterothorax, width 0.233 mm.; fore wings, length 0.720 mm., width at middle 0.036 mm., near base 0.068 mm.; abdomen, greatest width 0.306 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	24	40	55	50	47	51	10	13
Width (μ)	28	28	21	20	18	16	7	6

Total length of antenna 0.29 mm.

Described from five females taken by Mr. M. M. High on a nettle (*Stachys palustris*) at Knox (type locality) and Ober, Indiana, August 1 and July 16, 1914, respectively.

Structurally this species differs from *variabilis, annulipes,* and *beachæ* in lacking the two additional bristles which frequently occur in this genus near the tip of the wing, in a series posterior to the longitudinal vein. The specific name is in reference to this fact. In coloration it is most like *beachæ,* but in addition to the wing character just mentioned, it has a much more finely striated pronotal blotch than that species.

Sericothrips spiritus new species.

Female (macropterous).—Color uniform yellowish white, without markings on body, wings, or legs; antennæ colorless, excepting for a narrow brown

ring at extreme apex of segment 4 and a faint brown cloud in apical portion of 5 and 6; ocellar pigment very pale yellow.

Head broad, fully 1.9 times as wide as long, widest across eyes, narrowest just behind them, cheeks decidedly arched, surface without noticeable sculpture, bristles as usual in the genus. Eyes relatively small and widely separated, hardly 0.6 as wide as their interval, pilose. Antennæ about three times as long as head, segments as usual in this group of the genus. Mouth cone short, about attaining posterior margin of prosternum, not slenderly prolonged at tip.

Prothorax broad and heavy, about 1.6 times as long as head and 1.6 times as wide as long; pronotum with the usual, raised, anastomosing lines, which are closely spaced; bristle at posterior angles colorless and hardly half as long as pronotum. Fore wings with all bristles white and inconspicuous; costal margin with about 31 bristles; longitudinal vein with 3 + 20, the distal one more widely separated than the others; one additional bristle in a second series at tip of wing; hind wing with a median vein which is not darkened.

Abdomen stouter than usual, without color markings; pubescence white and almost invisible; all bristles slender, colorless, and very inconspicuous.

Measurements of holotype (♀): Length 1.13 mm.; head, length 0.084 mm., greatest width (across eyes) 0.162 mm., least width (just behind eyes) 0.149 mm.; eyes, length 0.064 mm., width 0.044 mm., interval 0.074 mm.; prothorax, median length of pronotum 0.132 mm., width 0.208 mm.; pterothorax, width 0.285 mm.; abdomen, greatest width 0.300 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)				48	42	48	11	14
Width (μ)	26	27	18	18	16	16	6	5

Total length of antenna 0.26 mm.

Described from one female taken at Tucson, Arizona, April 23, 1914, on cottonwood, by Bert R. Coad [Hood, No. 221].

In coloration this species is comparable only with *sambuci* and *albus*, agreeing with the former in the short and rather stout mouth cone, but differing from it in having the antennæ nearly clear white; the ocellar pigment very pale yellow; and the fore wings colorless, with bristles and fringes glass-clear and a single bristle near tip of wing, behind longitudinal vein.

Bagnalliella glaucæ new species. (Pl. XIII, Fig. 4.)

Female, forma macroptera.—Length about 1.7 mm. Color brownish yellow with head (especially anteriorly and at sides), usually the pterothorax, and always the last four or five abdominal segments, darkened with blackish brown, the tube paler at base and at apex; *subhypodermal pigmentation yellow or slightly orange-yellow by reflected light,* and (because of its partial opacity) *grayish yellow by transmitted light;* ocellar pigmentation bright red by reflected light, very deep purplish red by transmitted light;

antennæ bright lemon yellow, decidedly darkened with brown in segments 1 and 2 and with gray in at least the apical portion of segment 8; fore legs yellow, with femora blackish brown on outer surface; mid and hind legs brown, with tarsi and both ends of femora and tibiæ, yellow; fore wings brown to end of scale, thence nearly clear.

Head very large and broad, about 1.1 times as long as greatest width, broadest shortly behind eyes, sides broadly rounded and narrowed to base, which is about 0.86 the greatest width; vertex very slightly and roundly produced in front of eyes, slightly overhanging, the anterior ocellus not attaining frontal costa; dorsal and lateral surfaces almost perfectly smooth, bristles minute and almost invisible; postocular bristles short, hardly one-seventh as long as head, pointed, situated close to eyes and to sides of head. *Eyes very small, about as wide as long, hardly one-fourth as long as head, only 0.56 as wide as their interval. Ocelli of posterior pair widely separated, about 1.8 times as far apart as their distance from anterior ocellus.* Antennæ about 1.44 times as long as head, of normal form; sense cone formula: 3, 1–1; 4, 2–2; 5, 1–1^{+1}; 6, 1–1^{+1}; 7 with the usual one on dorsum near apex. Mouth cone short, about attaining middle of prosternum, labium semicircularly rounded at apex.

Prothorax across coxæ only 1.4 times as wide as head and about twice as broad as median length of pronotum, which is about 0.64 the length of head; surface without sculpture; midlateral and anterior marginal bristles exceedingly minute, anterior laterals pointed and shorter than postoculars, the two pairs at posterior angles longer and either blunt or slightly dilated at tip. Wings slightly narrowed at middle, without longitudinal vein, fore pair with about six accessory hairs and the subbasal bristles minute (one apparently lacking at times). Tarsal tooth minute. Abdomen slightly wider than pterothorax, without sculpture. Tube less than one-half as long as head and 1.6 times as long as basal width, which is fully twice the apical, sides straight. All abdominal bristles pointed, terminal bristles longer than tube.

Measurements of holotype (♀): Length 1.71 mm.; head, length 0.263 mm., greatest width 0.237 mm., width at base 0.203 mm.; eyes, length 0.062 mm., width 0.056 mm., interval 0.100 mm.; prothorax, length 0.168 mm., width across coxæ 0.330 mm.; pterothorax, width 0.360 mm.; abdomen, width 0.383 mm.; tube, length 0.122 mm., width at base 0.076 mm., width at apex 0.036 mm.

Antennal segments:	1	2	3	4	5	6	7	8
Length (μ)	40	52	48	50	52	52	52	34
Width (μ)	42	36	32	35	32	26	22	13

Total length of antenna, 0.38 mm.

Female, forma brachyptera.—Apparently identical with the macropterous form except that the pterothorax is very slightly narrower and usually paler and the eyes and ocelli are somewhat smaller.

Male (brachypterous).—Length about 1.5 mm. Color as in female, but prothorax and fore legs often somewhat enlarged, and tarsal tooth always longer and stronger.

Described from 28 females (of which 4 are macropterous) and 21 males (all brachypterous), as enumerated below:

Colorado: Boulder (type locality), July 2, 1924, on leaves of *Yucca glauca,* L. O. Jackson; 12 ♀, 10 ♂ (*holotype, allotype,* and *paratypes*).

Colorado Springs, Sept. 20, 1924, on leaves of *Yucca glauca,* L. O. Jackson; 16 ♀, 11 ♂ (*paratypes*).

Readily known from *yuccæ,* the only other species of the genus occurring in America, by the characters which have been italicized in the above description. The most conspicuous difference lies in the color of the subhypodermal pigmentation, which in *yuccæ* is bright red.

EXPLANATION OF PLATES

(Clara Husted, Inez D'Amanda, and J. D. H., del.)

PLATE XIII

FIG. 1.—*Æolothrips wetmorei* Hood, ♀, paratype, head and prothorax; all bristles omitted.

FIG. 2.—*Æolothrips vehemens* Hood, ♀, paratype, head and prothorax; all bristles omitted.

FIG. 3.—*Æolothrips oculatus* Hood, ♀, holotype, head and prothorax; all bristles omitted.

FIG. 4.—*Bagnalliella glaucæ* Hood, ♀, holotype, head and prothorax; all minor bristles omitted.

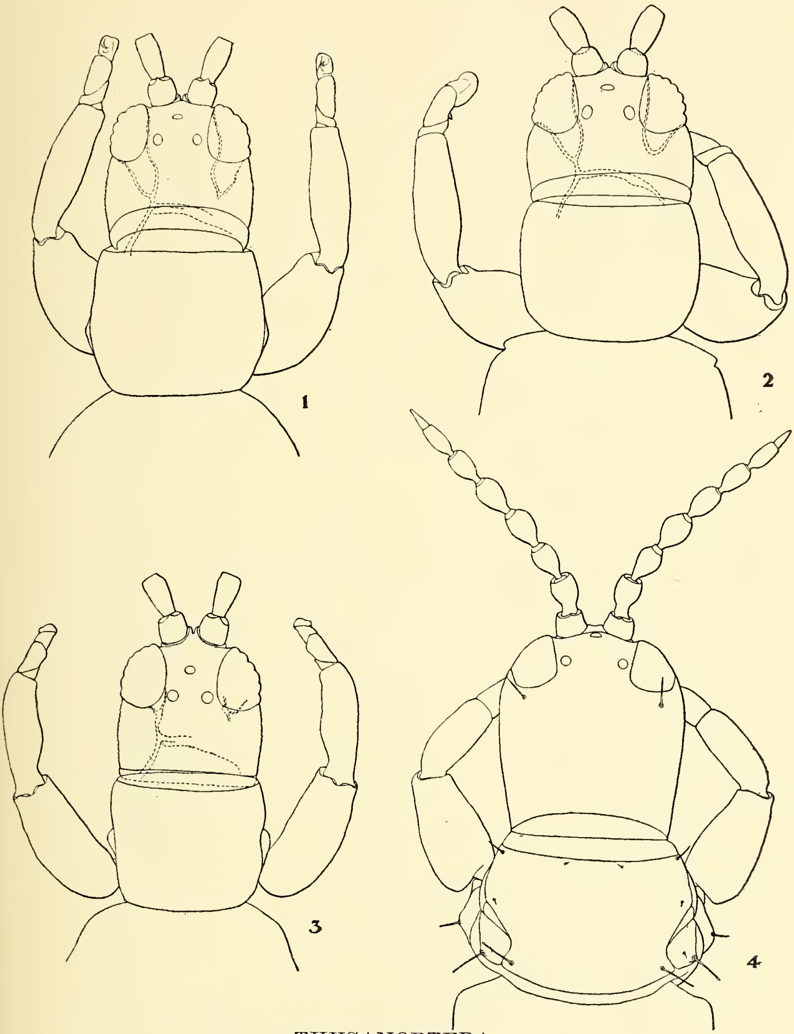
PLATE XIV

FIG. 1.—*Sericothrips pedicellatus* Hood, ♀, holotype, left antenna; all sense cones and bristles omitted.

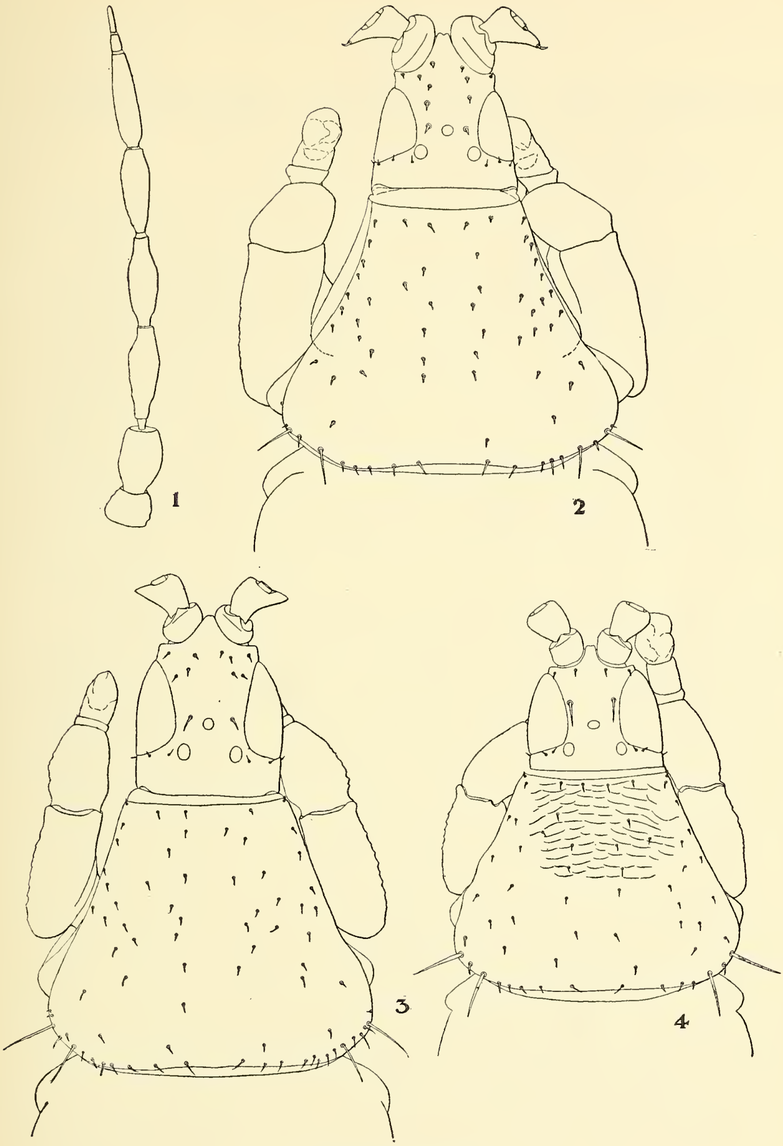
FIG. 2.—*Chirothrips crenulatus* Hood, ♀, holotype, head and prothorax; all bristles on appendages omitted.

FIG. 3.—*Chirothrips productus* Hood, ♀, holotype, head and prothorax; all bristles on appendages omitted.

FIG. 4.—*Chirothrips simplex* Hood, ♀, paratype, head and prothorax, showing sculpture of a portion only of pronotum; all bristles on appendages omitted.



THYSANOPTERA



THYSANOPTERA

NEW SPECIES OF ERIGONEAE AND THERIDIIDAE

BY C. R. CROSBY AND SHERMAN C. BISHOP

Oedothorax platyrhinus new species. (Pl. XV, Figs. 1–5.)

Male. Length, 1.3 mm. Cephalothorax dusky yellowish; viewed from above widest behind the middle, rounded on the sides behind; the sides then straight and converging to near the end of the greatly protruding clypeus which is rounded and slightly emarginate at tip; viewed from the side steeply ascending in a straight line to the cervical groove. There are two cephalic lobes separated by a deep transverse groove in line with the posterior median eyes. The posterior lobe is larger and higher than the anterior. The front of the anterior lobe is steep. The clypeus is extremely protuberant in the form of a flattened snout which projects forward and is bent downward. On the upper surface there are two parallel low ridges extending from the lateral eyes to the tip of the snout. The ridges are darker and clothed with out-turned stiff hairs. The snout extends beyond the femur of the palpus.

Posterior eyes in a strongly procurved line, the median larger than the lateral, separated by twice the diameter and from the lateral by one and one-third times the diameter. Anterior eyes in a strongly procurved line, the median smaller than the lateral, separated by the radius and from the lateral by one and one-half times the diameter. Sternum gray over pale yellowish, darker at margin, as broad as long, rounded convex, and broadly produced between the hind coxæ, which are separated by a little more than the diameter. Labium dark, endites pale. Legs and palpi pale yellowish white. Abdomen above whitish with a dusky short median stripe; below grayish, blackish around the spinnerets.

Femur of palpus thickest just beyond the middle, patella large and stout, widened distally. Ratio of length of femur to that of patella as 15 to 8. Tibia short and armed with a long straight blunt-tipped dorso-lateral apophysis. The lateral margin bears a submarginal row of five very long slender hairs. Paracymbium broad at base, strongly curved, and hooked at tip. The posterior angle of the bezel produced with a distinct blunt black tooth. The tail-piece of the embolic division broad, flat and pear-shaped (Fig. 2, *t. p.*). The apical part of the embolus emerges from the edge of the bezel as a short black curved process with three small teeth at the tip. The median apophysis can be seen as a small sharp black tooth behind the embolus.

Female. Length, 1.5 mm. Colored like the male. Cephalothorax viewed from above rather long, rounded on the sides, slightly constricted at the cervical groove and bluntly rounded in front; viewed from the side, strongly

arched over the back to the posterior eyes. Clypeus straight and protruding. Posterior eyes in a procurved line, equal and equidistant, separated by about the diameter. Anterior eyes in a very slightly procurved line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter. Clypeus narrower than the median ocular area. The epigynum (Fig. 5) consists of a broad strongly convex, transverse plate, evenly and gently convex behind.

Holotype male, allotype female.

Type locality: Mt. Pisgah, N. C., 3,000 ft., Oct. 19, 1923, 2 ♂, 2 ♀.

North Carolina: Oteen, Oct. 16, 1923, 1 ♂, 1 ♀.

Virginia: Anna River, Oct. 28, 1923, 2 ♂.

Pennsylvania: Roxbury, Oct. 30, 1924, 2 ♀.

Oedothorax eranistes new species. (Pl. XV, Figs. 6–7.)

Male. Length, 1.2 mm. Cephalothorax yellowish gray with indistinct radiating lines, darker on the margin; viewed from above, evenly rounded on the sides, slightly constricted at the cervical groove, converging and rounded on the sides of the head, squarely truncate in front; viewed from the side, steeply ascending in a straight line to the back of the head, then rounded down to the anterior median eyes, a distinct hump back of the eyes; clypeus strongly protuberant, slightly convex above and slanting forward, strongly retreating below. Cheliceræ small and strongly retreating.

Posterior eyes in a procurved line, equal, the median separated by three times the diameter and from the lateral by one and one-half times the diameter. Anterior eyes in a straight line, the median a little smaller than the lateral, subcontiguous, separated from the lateral by a little more than twice the diameter of the median. Clypeus a little wider than the median ocular area. Sternum greenish gray with a tinge of yellow, strongly convex, rounded on the sides, produced in a truncate point between the hind coxæ which are separated by the diameter. Labium and endites dusky yellow. No tooth on face of chelicera. Legs and palpi light yellowish. Abdomen dark greenish gray, with a few narrow transverse light lines posteriorly.

Femur of palpus short, stout, rather strongly curved. Patella long, gently arched above and armed below at tip with a large round-tipped process. Tibia short and strongly flaring; the dorso-mesal margin produced with a thin, rounded lobe; dorso-laterally produced with a short, broad, thin strongly incurved apophysis the distal margin of which is black and smooth. Paracymbium strongly curved, slightly hooked. Tegulum with a distinct protuberance on the ventral face. Bezel low. Tail-piece of the embolic division an elongate lobe, slightly constricted near the base (Fig. 7, *t. p.*). The tip rounded and extending on the edge of the tegulum. The embolus (Fig. 7, *em.*) arises with a sharp bend near the middle, about as long as the tail-piece, inclined towards the bezel, the tip erect and directed distally. The median apophysis appears as a rounded brownish lobe.

Holotype male.

Virginia: Alberta, Oct. 28, 1923, 1 ♂.

Oedothorax sarcocuon new species. (Pl. XV, Figs. 8–10.)

Male. Length, 1.4 mm. Cephalothorax smooth greenish gray; viewed from above, very broad, evenly rounded on the sides to a point in front, cervical and dorsal grooves distinct; viewed from the side rather low back of the cervical groove and gently ascending, then abruptly elevated and rounded over the cephalic lobe. The cephalic lobe high, broad behind and narrow in front bearing all the eyes. Below anterior eyes is a deep transverse groove widened at the ends. Clypeus viewed from the side notched just below the eyes at the transverse furrow, then strongly protuberant like the profile of the nose of a lion.

Posterior eyes in a recurved line, equal, separated by a little more than the diameter and from the lateral by the diameter. Anterior eyes in a straight line, the median much smaller than the lateral, subcontiguous and separated from the lateral by twice the diameter. Clypeus twice as wide as the median ocular area.

Sternum dark greenish gray, rather long, sides convergent to the hind coxæ, then abruptly narrowed, produced in a truncate point between the hind coxæ which are separated by a little more than the diameter. Labium same color as the sternum. Endites dusky yellowish. No tooth on face of chelicera. Legs and palpi yellowish white. Abdomen light grayish brown, darker beneath with usual two white lines clothed with black hairs.

Femur of palpus rather stout, moderately curved. Patella rather long, slightly arched. Ratio of length of femur to that of patella as 20 to 8. Tibia about as long as patella, widened distally. The dorsal margin produced into two, strong, blunt, black teeth; on the mesal side the edge is incurved, giving the appearance of a third tooth. On the lateral ventral side the tibia is produced into a large lobe on the front angle of which there is a short, broad, semi-transparent, triangular tooth. Between this lobe and the latero-dorsal tooth is a broad square imargination, along the edge of which are six long, black hairs. Paracymbium rather slender, strongly curved and hooked at the tip. The bezel is very narrow on the side next to the paracymbium but ventrally produced into a large, rounded protuberance. The embolus is long, black, shining, stout at base and moderately curved and arises from the lateral side of a bulb-like base.

Holotype male.

Pennsylvania: Potters Mills, Oct. 31, 1924, 2 ♂.

Oedothorax limnæus new species. (Pl. XVI, Figs. 11–14.)

Male. Length, 1.3 mm. Cephalothorax dusky yellowish with the margin and radiating lines darker; viewed from above evenly rounded on the sides, strongly convergent towards the front, slightly but distinctly constricted at the cervical groove, broadly rounded across the front; viewed from the side, the posterior declivity rather steep, nearly flat on top, rounded over the head

to the posterior eyes. Head armed with a median row of stiff black hairs directed forward. Clypeus straight and almost vertical.

Posterior eyes in a straight line, equal, equidistant, separated by a little less than the diameter. Anterior eyes in a nearly straight line, the median smaller than the lateral, separated by the radius and from the lateral by the diameter. Clypeus a little narrower than the median ocular area.

Sternum dark greenish gray with a few minute yellowish spots, strongly convex, rounded on the sides, produced in a truncate point between the hind coxæ which are separated by a little less than the diameter. Labium same color as sternum. Endites dusky yellow. Cheliceræ dusky orange armed on the inner side of the face with a row of setigerous tubercles, the lower one larger than the other. Legs and palpi dull yellowish, coxæ below marked with grayish, darker on the margin. Abdomen dark greenish gray.

Femur of palpus curved and slightly widened distally. Patella short and rather strongly arched above. Ratio of length of femur to that of patella as 15 to 5. Tibia a little longer than patella, the dorsal margin broadly rounded with a small, sharp, incurved black tooth on the dorso-lateral angle. Paracymbium enlarged at the base where it articulates with the cymbium. This enlargement is opposed to the tooth on the dorso-lateral margin of the tibia. Paracymbium large, strongly curved and on the ventral side it is greatly widened so that when viewed in this aspect it is triangular. Apposed to the paracymbium on the ventral side is a slender process widened and truncated at the tip, coming from the opposite side of the cymbium (Fig. 13, *x*). The end of this process is bent ventrally and almost touches the paracymbium. The bezel is low. The tegulum is ventrally somewhat protuberant but not provided with a tooth. The embolic division consists of a bulb-like base which lies across the tip of the palpal organ next to the edge of the cymbium; the embolus arises from the ventral side of the basal part and makes a semicircular curve around the end of the bulb, the tip lying at the edge of the cymbium. The median apophysis appears as a small, rounded, blackish tooth near the bezel.

Female. Length, 1.3 mm. Similar to male in form and color. Cheliceræ armed on the inner side of the face with a row of three stiff bristles. Epigynum (Fig. 14) a broad convex plate, evenly and broadly rounded behind, the middle part of the hind margin upturned so as to leave a transverse depression in front of it.

Holotype male, allotype female.

Colorado: Pingree Park, Larimer Co., Aug. 20, 1924, 23 ♂, 62 ♀. In moss by pond.

New York: McLean, May 30, 1919, 8 ♂, 10 ♀; May 8, 1919, 2 ♂, 1 ♀; May 6, 1920, 1 ♂; May 14, 1921, 10 ♂, 21 ♀. In moss by pond.

Oedothorax potamius new species. (Pl. XVI, Figs. 15–16.)

Male. Length, 1.5 mm. Cephalothorax dusky orange, a little darker at the margin; viewed from above evenly rounded on the sides, slightly con-

vergent towards the front, broadly rounded in front; viewed from the side, rather steeply ascending on the posterior declivity, then gradually ascending to the posterior eyes. Clypeus nearly straight and protruding.

Posterior eyes in a straight line, equal, equidistant, separated by a little less than the radius. Anterior eyes in a straight line, the median smaller than the lateral, equidistant, separated by a little less than the radius of the median. Clypeus only about half as wide as the median ocular area. A tooth on the face of chelicera.

Sternum grayish yellow, narrowly margined with black, broad, rounded on the sides and produced in a truncate point between the hind coxæ which are separated by a little less than the diameter. Labium same color as sternum. Endites dusky orange-yellow. Legs and palpi dirty yellow. Coxæ narrowly margined with black distally. Abdomen greenish gray, darker towards the tip.

Femur of palpus rather slender, moderately curved. Patella short, almost straight. Tibia short greatly widened distally, a broad, shallow rounded notch on the dorsal margin; dorso-mesally produced into a broad, flat, rectangular lobe the corners of which are acute, each bearing a long stiff hair directed towards the cymbium. The dorso-lateral angle has a rounded lobe which on the side next to the paracymbium has a small semicircular notch; on the base of the paracymbium, there is a row of three very long stiff hairs, the basal one the largest. The terminal part of the paracymbium broadly rounded at base, broad at the apex, and very strongly hooked. Bezel rather high, pointed, rounded at the tip. Tail-piece of the embolic division (Fig. 16, *t. p.*) a rounded bulb-like plate, lying at the base of the genital bulb, the tip extending over the edge of the tegulum on the side next to the paracymbium. The embolus arises directly from the tail-piece and has a sharp, double curve, the slender terminal part lying deep back in the alveolus. The tip extends distally and is protected by a membranous conductor. The median apophysis appears as two sharp teeth between the bezel and the edge of the cymbium.

Holotype male.
Virginia: Great Falls, Apr. 3, 1921, 1 ♂.
Illinois: Salts, July 23, 1926, 1 ♂ (V. G. Smith).

Oedothorax pidacitis new species. (Pl. XVI, Figs. 17–18.)

Male. Length, 1.9 mm. Cephalothorax dirty greenish white with darker radiating lines, darker at the margin; viewed from above evenly rounded on the sides to the front, broadly rounded in front; viewed from the side steeply ascending on the posterior declivity, nearly flat on top and then rounded down to the eyes. Clypeus straight and vertical. On the head there is a median row of three long black hairs directed forward.

Posterior eyes in a slightly procurved line, equal and equidistant, separated by the diameter. Anterior eyes in a straight line, the median smaller than the lateral, all separated by a little less than the diameter of the median. Clypeus a little wider than the median ocular area.

Sternum greenish gray, shrunken. Labium same color as sternum. Endites dirty white. Legs and palpi waxy white. Abdomen mottled gray and brown.

Femur of palpus moderately long and stout, rather strongly curved, and widened distally. Patella moderately long, straight. Ratio of length of femur to that of patella as 26 to 9. Tibia strongly produced dorsally with a large rounded excavation on the lateral half, leaving a dorsal process rounded on the mesal side and concave on the lateral side. The edge of the excavation is black, contrasting strongly with the rest of the tibia. On the lateral side of the excavation there is a low, triangular black tooth, mesad of which the margin is finely denticulate. The paracymbium is large and curved over; when viewed ventrally, the basal part is oval with a rather long curved branch hooked at tip, extending toward the edge of the cymbium. The bulb-like base of the embolic division is broadly pyriform with its base lying close to the cymbium (Fig. 18, *t. p.*). The embolus is stout at base, long and spirally curved, making about one complete turn. The first half of the turn lies back under the cymbium and the slender tip projects diagonally forward from the tip of the bulb, where it is supported by a large membranous conductor. The median apophysis is a short, black, blunt-pointed, curved tooth, lying under the outer curve of the embolus.

Holotype male.

Colorado: Pingree Park, Larimer Co., Aug. 20, 1924. In moss by a spring, 10,000 ft., 1 ♂.

The following species in superficial characters strikingly resemble members of the genus Ceraticelus of the Argiopidæ. In fact we considered it as belonging to that genus until we came to study the structure of the palpal organ. These forms exemplify to a striking degree the phenomenon of convergence in superficial characters although they belong to distinct families.

Family THERIDIIDAE

Micropholcomma new genus

Closely related to *Pholcomma Thorell*, from which it may be distinguished by having the metatarsi of the legs very much shorter than the tarsi, less than one-half as long.

Type *M. cæligenus* new species, described below.

Micropholcomma cæligenus new species. (Pl. XVI, Fig. 19.)

Male. Length, .8 mm. Cephalothorax viewed from above rather broad, evenly rounded on the sides to the eyes, bluntly rounded in front; viewed from the side, very high, steeply ascending behind, broadly rounded over the back down to the eyes, highest in front of the posterior declivity where

there arises a pair of long, erect, stiff hairs curved forward. Clypeus straight, retreating. Cephalothorax yellow-orange in ground color, distinctly marked with blackish radiating lines and with a rectangular pattern on the back.

Posterior eyes in a straight line, the median separated by a little less than the diameter and a little nearer to the lateral. Anterior eyes in a distinctly procurved line, the median much smaller than the lateral, separated by a little less than the diameter and almost touching the lateral. Width of clypeus one and one-half times the diameter of an anterior lateral eye.

Sternum smooth and shining, reddish orange in ground color and strongly mottled with blackish, broadly and squaiely truncate behind. Hind coxæ separated by more than the diameter. Labium same color as sternum. Endites yellow-orange marked with fine black dots. Cheliceræ orange-yellow, divergent, obliquely truncate within and armed with a long, slender, strongly curved claw. Legs orange-yellow, patella lighter, metatarsi not over half as long as tarsi. Abdomen almost entirely covered by a smooth grayish orange sclerite. Epigastric sclerite strongly developed and produced behind in two converging points. Mammillary sclerite surrounds the spinnerets. Soft parts of abdomen yellowish, mottled and streaked on the sides with greenish and reddish orange.

Femur of palpus short and thick; patella stout, nearly as long as femur, curved downward at base, viewed from the side oval and provided with a pointed process on the ventro-lateral angle; tibia shorter than patella, broader distally and attached to the patella on the inner upper side; tarsus small and rounded. The embolus arises on the face of the bulb and makes one complete turn. Lateral edge of cymbium provided with four or five long, slender hairs.

Type male. Emerald, Australia, June 9, 1924. Stanley Butler coll.

All types in the collection of Cornell University.

EXPLANATION OF PLATES

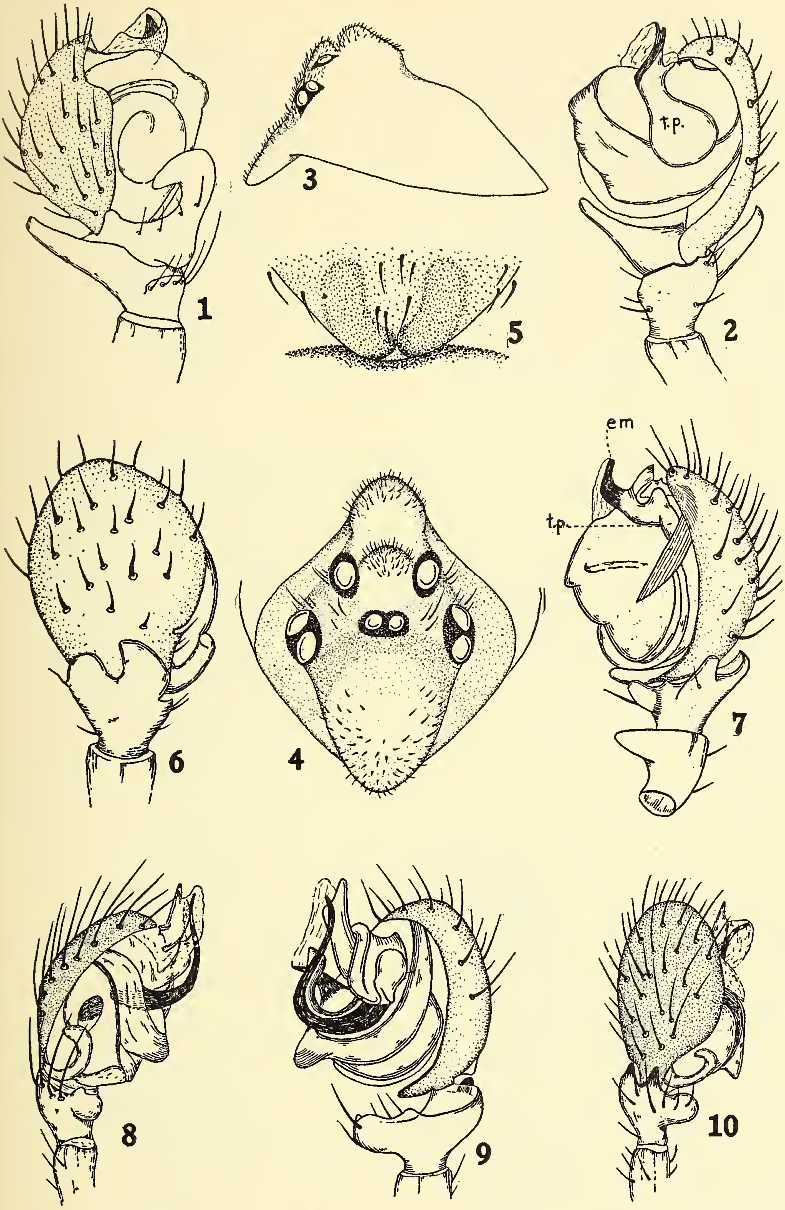
(All the drawings were made by Mr. W. J. Schoonmaker)

PLATE XV

FIG. 1. *Oedothorax platyrhinus,* lateral view of palpus.
FIG. 2. *Oedothorax platyrhinus,* mesal view of palpus.
FIG. 3. *Oedothorax platyrhinus,* lateral view of cephalothorax. ♂.
FIG. 4. *Oedothorax platyrhinus,* front view of head. ♂.
FIG. 5. *Oedothorax platyrhinus,* epigynum.
FIG. 6. *Oedothorax eranistes,* dorsal view of male palpus.
FIG. 7. *Oedothorax eranistes,* mesal view of male palpus.
FIG. 8. *Oedothorax sarcocuon,* lateral view of male palpus.
FIG. 9. *Oedothorax sarcocuon,* mesal view of male palpus.
FIG. 10. *Oedothorax sarcocuon,* dorso-lateral view of male palpus.

PLATE XVI

FIG. 11. *Oedothorax limnæus,* lateral view of male palpus.
FIG. 12. *Oedothorax limnæus,* dorsal view of male palpus.
FIG. 13. *Oedothorax limnæus,* mesal view of male palpus.
FIG. 14. *Oedothorax limnæus,* epigynum.
FIG. 15. *Oedothorax potamius,* dorso-lateral view of male palpus.
FIG. 16. *Oedothorax potamius,* ventral view of male palpus.
FIG. 17. *Oedothorax pidacitis,* dorsal view of male palpus.
FIG. 18. *Oedothorax pidacitis,* ventral view of male palpus.
FIG. 19. *Micropholcomma cœligenus,* lateral view of male palpus.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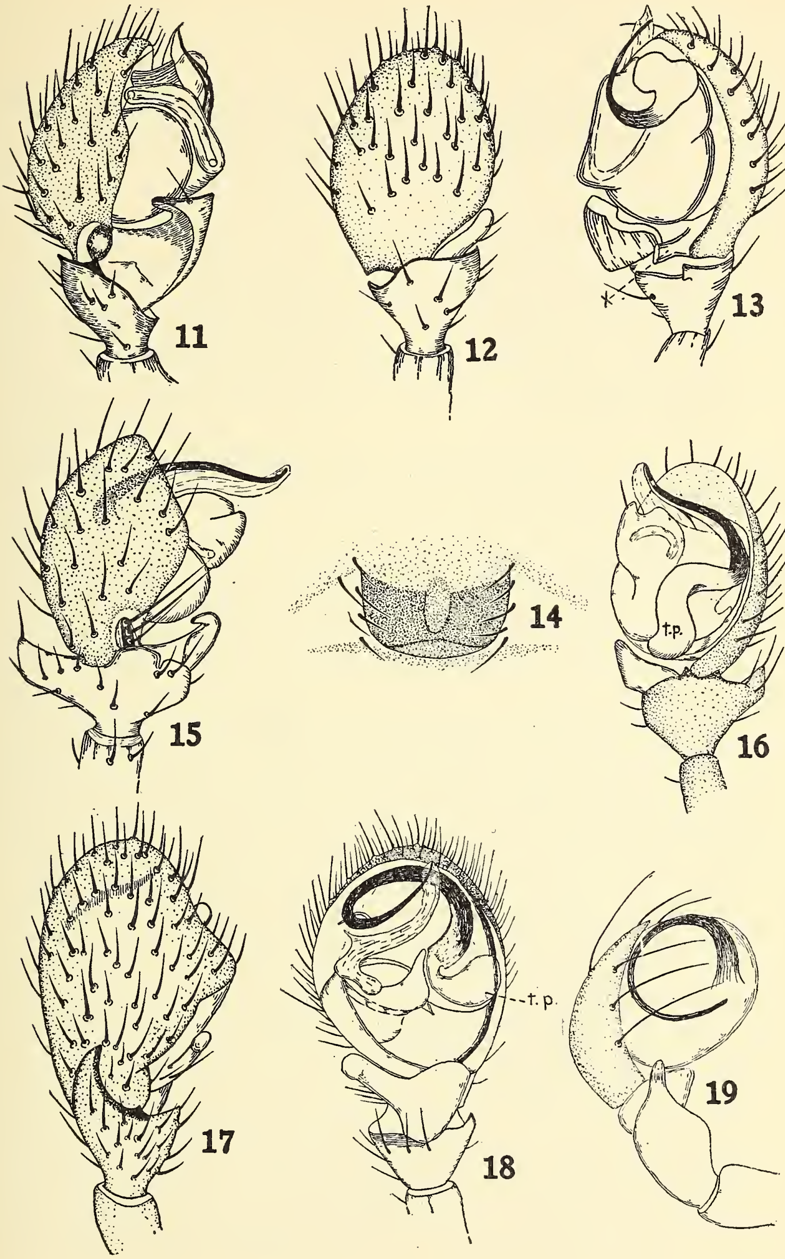
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NEW MEMBRACIDAE COLLECTED BY THE CORNELL SOUTH AMERICAN EXPEDITION

By W. D. FUNKHOUSER

Through the courtesy of Dr. J. Chester Bradley, of Cornell University, the writer has been permitted to examine a considerable collection of Membracidæ, most of which were taken in South America by the Cornell Expedition of 1920.

In this collection were found seven new species which may be described as follows:

1. **Membracis nigrolutea** new species. (Pl. XVII, Fig. 1.)

Near *M. rosea* Fairmaire but larger and with the markings entirely yellowish white.

Large, black, pronotum angular anteriorly, a distinct carina from anterior angle of foliaceous pronotum to arcuate band above shoulders; sordid yellowish-white band beginning above head, extending arcuately over humeral angles, then straight to dorsal margin; large irregular yellowish-white spot at base of posterior process; tegmina entirely black; undersurface and legs black.

Head longer than wide, black, shining, foliaceous, very finely punctate, not pubescent; base feebly sinuate; eyes large, black; ocelli large, prominent, translucent, farther from each other than from the eyes and situated about on a line drawn through centers of eyes; clypeus nearly as broad as long, extending for nearly half its length below inferior margins of genæ and continuing the general marginal line of the genæ, slightly concave in center, faintly bicarinate in middle, tip rounded and sparsely pilose.

Pronotum strongly foliaceous, finely punctate, not pubescent, black with sordid yellowish-white markings; humeral angles obtuse, blunt, not prominent; metopidium extended in a broad flange over head; dorsal margin bluntly angular above; a strong carina on each side from angle of pronotum to lateral fascia; a broad, regular, yellowish-white fascia on each side arising at base of head, arcuate over humeral angles and then straight to dorsal margin; a large irregular yellowish-white spot covering base of posterior process; posterior process short, heavy, foliaceous, blunt, extending beyond internal angles but not reaching tips of tegmina.

Tegmina entirely black, opaque; veins indistinct; apical limbus broad, wrinkled; five apical and two discoidal areas.

Sides of thorax, undersurface, abdomen and legs entirely black; first two pairs of legs broadly foliaceous.

Length from front of head to tips of tegmina 8.2 mm.; from anterior tip of pronotum to tips of tegmina 10 mm.; width between humeral angles 3 mm.

Type: female. Male similar but smaller.

Described from ten females and four males all collected at Diamantina, Minas Geraes, Brazil, November 18, 1919. Type, allotype and ten paratypes in Cornell Collection; two paratypes in author's collection.

2. **Aconophora projecta** new species. (Pl. XVII, Fig. 2.)

Small, yellow-brown, punctate, pubescent; pronotal process projecting forward and slightly upward; posterior process extending slightly beyond internal angles of tegmina; veins of tegmina strongly pilose; undersurface dark brown; legs yellow-brown.

Head black in center, yellow-brown at margins, twice as wide as long, finely punctate, not pubescent; base feebly sinuate; eyes yellow; ocelli very small, inconspicuous, yellow, about equidistant from each other and from the eyes and situated on a line drawn through centers of eyes; inferior margins of genæ strongly sinuate; clypeus longer than wide, deflexed, base black, tip brown, extending for half its length below inferior margins of genæ.

Pronotum yellow-brown, finely punctate, sparsely pubescent; metopidium twice as broad as high with an irregular smooth brown patch above each eye; humeral angles prominent, blunt; median carina percurrent; pronotal horn about as long as the distance from the base of the horn to the humeral angle, flattened laterally, lightly carinate above and below, projecting strongly forward and slightly upward; posterior process heavy, tectiform, sharp, extending beyond the internal angles of the tegmina and slightly beyond apex of abdomen but not nearly to the apices of tegmina.

Tegmina hyaline; veins brown and distinctly pilose; base narrowly opaque and punctate; apical limbus broad and wrinkled.

Sides of thorax and abdomen very dark brown; legs and feet uniformly yellow-brown.

Length from front of head to tips of tegmina 5 mm.; length from tip of pronotal horn to tips of tegmina 7 mm.; width between tips of humeral angles 2.4 mm.

Type: female. Male similar.

Described from eleven females and two males, all collected at Cochabamba, Bolivia, April 29–May 4, 1920, by Mr. R. G. Harris. Type, allotype and eight paratypes in Cornell Collection; three paratypes in author's collection.

3. **Ceresa cuprea** new species. (Pl. XVII, Fig. 3.)

Large, shining, bronze-brown, punctate, not pubescent; short suprahumeral horns pointing outward, downward and backward; posterior process slender, not reaching apex of internal apical cell of tegmina; tegmina entirely bronze-hyaline; undersurface and legs bronze-brown.

Head twice as broad as long, shining brown, not punctate, not pubescent, faintly longitudinally striate; base strongly arcuate in center; eyes large, prominent, yellow with brown striæ; ocelli small, bronze, inconspicuous, nearer to each other than to the eyes and situated about on a line drawn through centers of eyes; clypeus spindle-shaped, apex faintly trilobed, extending for half its length below inferior margins of genæ.

Pronotum shining bronze-brown, coarsely punctate, not pubescent; metopidium very convex, broader than high, a large irregular smooth yellowish area above each eye; humeral angles small, blunt, inconspicuous; median carina percurrent; suprahumeral horns short, not quite as long as half the distance between their bases, sharp, extending outward, distinctly downward and slightly backward, base conical, tip sharp and black; semicircular impression faint; dorsum well arched in center; posterior process suddenly slender, sharp, dark brown, tip acuminate and reaching to a point about one-third the distance between the internal angle and tips of tegmina.

Tegmina uniformly bronze-hyaline; veins distinct; base narrowly opaque and punctate; apical limbus broad; five apical and two discoidal cells.

Sides of thorax, undersurface, abdomen and legs dark cupreus.

Length from front of head to tips of tegmina 8.2 mm.; width between tips of suprahumeral horns 5.5 mm.

Type: male.

Described from a single specimen taken at Bauru, S. Paulo, Brazil, December 4, 1919. Collector: Harris. Type in Cornell Collection.

4. **Ceresa projecta** new species. (Pl. XVII, Fig. 4.)

Greenish with brown punctures; suprahumeral horns projecting strongly forward, outward and upward; posterior process long, slender, decurved, reaching almost to tips of tegmina; two lateral white fascia on suprahumerals; eyes brown; undersurface and legs luteus; tegmina hyaline; pronotum not strongly elevated.

Head nearly twice as broad as long, yellow, roughly sculptured with longitudinal striæ, coarsely punctate, not pubescent; base arcuate; eyes large, brown; ocelli large, red, conspicuous, slightly elevated, about equidistant from each other and from the eyes and situated slightly above a line drawn through centers of eyes; clypeus blunt, extending only slightly below the sinuate margins of the genæ and almost continuing the line made by these margins, tip rounded and strongly pilose, a faint brown line on each side.

Pronotum greenish, coarsely punctate with brown, not highly arched; metopodium broader than high, a smooth arcuate spot above each eye; humeral angles small, inconspicuous, extending laterad about as far as the eyes; median carina strongly percurrent; suprahumeral horns broad, flattened dorso-ventrally, about as long as the distance between their bases, projecting strongly forward, upward and outward, tips blunt, almost truncate, a narrow white fascia on each side of external surface extending from

tip to base; semicircular impression faint; posterior process long, slender, decurved, tectiform, impinging on tegmina and extending to middle of apical cell of tegmina.

Tegmina hyaline, somewhat wrinkled; base narrowly opaque and punctate; apical limbus narrow; veins prominent and brown.

Sides and undersurface of thorax sordid luteus; abdomen white; legs luteus, claws darker.

Length from front of head to tips of tegmina 7 mm.; width between tips of suprahumeral horns 4.2 mm.

Type: female.

Locality: Cosquin, Sierra de Cordoba, Argentina, March, 1920.

Described from a single specimen now in the Cornell Collection.

5. **Stictolobus maculatus** new species. (Pl. XVII, Fig. 5.)

Luteus with ferruginous spots on pronotum and dark brown markings on tegmina, coarsely punctate, sparsely pilose; shoulders rounded above humeral angles; posterior process slender, acuminate, reaching well beyond internal angles of tegmina but not extending to apices of tegmina; tegmina hyaline with brown markings; sides of thorax and abdomen yellow with black markings; legs yellow with ferruginous markings.

Head subtriangular, wider than long, yellow with ferruginous markings, smooth, shining, not punctate, not pubescent, faintly longitudinally striate; base nearly straight; eyes very large, conspicuous, yellow mottled with brown, extending as far laterad as the humeral angles; ocelli very large, conspicuous, amber-colored, somewhat elevated, nearer to each other than to the eyes and situated on a line drawn through centers of eyes; clypeus twice as long as wide, extending for more than half its length below inferior margins of genæ, tip rounded and pilose.

Pronotum luteus mottled with ferruginous, coarsely punctate, sparingly pilose with long scattered black hairs; metopidium sloping, about as broad as high, an irregular brown line above each eye; humeral angles blunt, median carina strongly percurrent; sides with semicircular impression; posterior process long, acuminate, a large brown spot at base, two smaller ones between base and tip, tip black and extending to a point about half way between internal angles and tips of tegmina and reaching slightly beyond apex of abdomen.

Tegmina hyaline with a large dark brown spot at base and a dark brown transverse fascia at middle; base narrowly coriaceous and punctate; veins very thick, prominent and brown; apical limbus wide and wrinkled.

Sides of thorax luteus with faint ferruginous markings; abdomen luteus strongly marked with black; legs ferruginous-yellow, hind trochanters marked with dark brown; tarsi luteus; ovipositor dark brown.

Length from front of head to tips of tegmina 6 mm.; width between tips of humeral angles 2.5 mm.

Type: female. Male similar.

Described from six females and two males, all collected at Passo Fundo, Rio Grande do Sul, Brazil, January 8, 1920. Type, allotype and four paratypes in Cornell Collection; two paratypes in author's collection.

6. **Aphetea maculata** new species. (Pl. XVII, Fig. 6.)

Near *A. inconspicua* Fowler but strongly marked with dark brown on pronotum and tegmina and with dorsal line more distinctly sinuate.

Green and dark brown, finely punctate, not pubescent, dorsum sinuate, tegmina partly covered by pronotum, undersurface and legs dark brown, legs simple.

Head twice as broad as long, green with strong black punctures, roughly sculptured, not pubescent; base sinuate; eyes brown; ocelli small, brown, inconspicuous, farther from each other than from the eyes and situated about on a line drawn through centers of eyes; clypeus triangular, continuing line of inferior margins of genæ, tip rounded, deflexed and pilose.

Pronotum tectiform, not highly elevated, rounded, covering about half of the tegmina, anterior half green, posterior half dark brown with a small green spot on median line before the apex; metopidium twice as broad as high, smooth brown transverse line over each eye; median carina percurrent; humeral angles large, prominent, blunt, extending laterad farther than the eyes; posterior process not distinctly set off from the rest of the pronotum, extending beyond middle of terminal cell of tegmina.

Tegmina half concealed by pronotum; basal two-thirds brown, coriaceous, opaque and punctate with veins indistinct; apical third hyaline with veins distinct; terminal cell triangular and petiolate.

Sides of thorax, undersurface of body and abdomen dark brown; legs brown margined with green, simple.

Length from front of head to tips of tegmina 3 mm.; width between tips of humeral angles 1.8 mm.

Type: female.

Locality: Upper R. Paohitea, Peru.

Described from a single specimen collected on July 21, 1920, by the Cornell Expedition. Type in Cornell Collection.

7. **Scytodepsa tricarinata** new species. (Pl. XVII, Fig. 7.)

Small, ferruginous, punctate, pubescent; pronotum with three prominent ridges; no suprahumerals, scutellum entirely exposed; no posterior process; tegmina coriaceous for basal two-thirds, transparent in apical third; head not produced nor lobate; legs simple.

Head about as broad as long, dark brown, finely punctate, densely pubescent with short white hairs, roughly sculptured; base regularly arcuate; eyes small, not conspicuous; ocelli small, brown, farther from each other than from the eyes and situated on a line drawn through centers of eyes; clypeus broader than long, feebly trilobate, continuing the line of the lateral margins of the genæ.

Pronotum ferruginous marked with brown, finely punctate, densely pubescent, elevated above to form three prominent carinæ; metopodium higher than broad, sloping above the head, a large irregular smooth area on each side above the head; median carina percurrent; humeral angles large, prominent, extending laterad much farther than the eyes; posterior process absent, the pronotum nearly truncate at posterior margin; scutellum entirely exposed, triangular, swollen, slightly longer than its width at base.

Tegmina entirely exposed, short, rounded; basal two-thirds coriaceous, opaque, punctate, pubescent, reddish-brown, veins indistinct; apical third hyaline with veins prominent; no apical limbus; five apical areas; clavus with two indistinct veins.

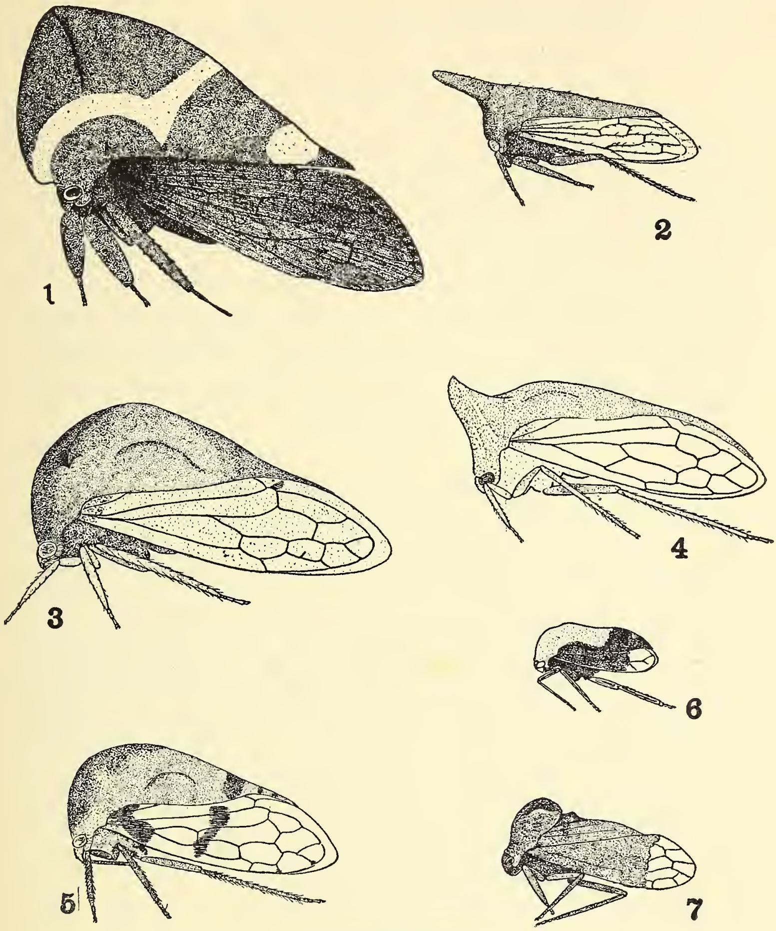
Sides of thorax, undersurface of body and abdomen dark brown; legs ferruginous brown; front tibiæ very slightly flattened.

Length from front of head to tips of tegmina 4.5 mm.; width between tips of humeral angles 1.7 mm.

Type: female.

Locality: Upper R. Paohitea, Peru.

Described from a single specimen collected by the Cornell Expedition on July 21, 1920. Type in the Cornell Collection.



MEMBRACIDAE

NEW MEMBRACIDAE. III

BY FREDERIC W. GODING

In a small lot of unnamed Membracidæ from Jamaica, forwarded to me for identification by Dr. Guy A. K. Marshall, director of the Imperial Bureau of Entomology, British Museum, were the following species: *Quadrinarea u-flava,* n. gen. et n. sp., 5 examples; *Marshallella rubripes,* n. gen. et n. sp., 7 examples; *Callicentrus aurifascia* Walk., 1 example; *Callicentrus cribratus* Walk., 2 examples; *Phormophora spreta,* n. sp., 1 example. They were collected by Mr. C. C. Gowdey, and are described below:

Subfamily CENTROTINÆ

Quadrinarea new genus.

Head with eyes broad as width between humerals, triangular, base straight not sinuate; eyes small; clypeus not extended below loræ; ocelli even with center of eyes, some distant from each other and base of head. Pronotum convex, unarmed, with a median carina lightly sinuate at middle of dorsum, densely punctured anteriorly more sparingly behind middle, distinctly notched behind humerals exposing a little of sides of scutellum, and covered with fine pale hairs; posterior process robust, not tectiform, apical fourth acuminate from above and laterally to acute apex which reaches tips of tegmina. Tegmina nearly free; clavus partly covered by sides of pronotum, clear hyaline excepting coriaceous base, sides nearly parallel, apex obtusely rounded, destitute of a longitudinal vein; corium emitting 2 longitudinal veins from base, radial vein forked at middle enclosing 1st exterior discoidal cell, ulnar vein simple; 3 discoidal cells the 1st exterior cell stylate, 2d cell behind it sessile base truncate, the 3d or interior cell equal and contiguous to the others in length, situate between radial and ulnar veins, sessile, its base truncate at a transverse venule; 4 sessile apical cells bases truncate. Wings with 3 apical cells, 1st and 2d sessile bases truncate, 3d stylate, second cell large and nearly semicircular, the others small. Legs strong, tibiæ slender not dilated, tarsi equal. Type, *Quadrinarea u-flava*, n. sp.

This genus is near *Brachycentrotus* and *Gargara;* it differs from the former in shape of head, position of ocelli, dorsum not depressed, acute apex passing far beyond apex of clavus, forked radial and simple ulnar veins, sessile 2d exterior and interior discoidal cells, and but 4 apical cells; it differs from the latter in the subopaque tegmina, 3 discoidal and 4 apical cells.

To include this genus in the "Classification," page 300, in "36(1)" last clause read "Corium with 4 or 5 apical cells." On page 301, in "53(60)" read "corium with 2 or 3 discoidal cells," etc. On page 301, in 57(54) read:

"57(54). Wings with 3 apical cells.

a. Corium with 4 apical cells and 3 discoidal cells 1st exterior cell stylate; clavus destitute of longitudinal veins; posterior pronotal process almost covering scutellum..............QUADRINAREA, Godg.

aa. Corium with 5 apical cells and 2 discoidal cells; clavus with a longitudinal vein."

Quadrinarea u-flava new species.

Piceous and chestnut-brown with a large lemon-yellow U-spot opening forward. Head piceous margined with yellow, punctate. Pronotum piceous or fuscous anteriorly, lateral margins narrowly yellow from base to and including posthumeral sinus; posterior process chestnut-brown, a large U-shaped spot on dorsum opening forward, its sides extended on lateral margins and narrowly fuscous margined, and a narrow oblique band each side before apex, lemon-yellow. Tegmina opaque brown from bases to bases of apical cells which are clear hyaline, veins punctate with short pale hairs, a smooth coriaceous white crescent-shaped narrow band across middle, the color deepening behind it to form a large circular spot; apical limbus rather broad. Abdomen yellow, base and apex piceous. Legs pale brown, with short pale hairs, tarsi darker.

Type, ♀, long. 4 mm.; lat. 2 mm.; three ♀ paratypes similar to the type, and one ♀ variety which has the u-spot indicated only by a short narrow band each side extended upward from lateral margins.

Habitat: the type, and three paratypes, with the variety are from Hill Gardens, and one paratype from Mona, Jamaica, all in the British Museum, No. 579, excepting one paratype in my collection.

Marshallella new genus.

Head broad, nearly equal to breadth between humerals, roughly sculptured, apical margins of loræ moderately foliaceous below which the clypeus is lengthily produced, an indistinct median carina; eyes large, almost globular; ocelli equidistant, slightly above a line through center of eyes. Pronotum densely punctured and strongly sculptured, base broadly sinuate, with a median carina, convex, unarmed above the prominent humerals; posterior process broad at base, close to and covering large part of scutellum, sides notched behind humerals then gradually acuminate to slender subulate apex, long as abdomen far passing apex of clavus, strongly tectiform, lateral margins broadly flat and smooth, strongly impressed within. Scutellum well

developed, exposed sides punctured, apex emarginate. Tegmina clear hyaline, veins strong, punctate; margins of clavus nearly parallel, slightly narrowed toward obtusely rounded apex, with 2 veins the exterior vein not percurrent, the interior vein short, base coriaceous and opaque; corium with 3 longitudinal veins from base, ulnar veins joined close to base by a transverse venule, 1st ulnar vein forked front of middle, 2d ulnar vein simple, radial vein forked at middle; 3 discoidal cells, exterior cell sessile base truncate, middle cell some longer stylate, interior cell much larger and longer extended toward truncate base at venule between ulnar veins; 5 apical cells; all cells elongate, limbus rather broad. Wings with 4 apical cells and a large triangular anal cell, the 1st, 3d and anal cells stylate, the 3d narrow at base very much broadened toward apex, 2d and 4th cells sessile bases truncate. Legs strong, rather long, tibiæ triquetrous covered with short pale hairs, tarsi equal. Type, *Marshallella rubripes,* n. sp.

This genus is near *Platycentrus* and *Orthobelus*; it differs from both in the unarmed pronotum, from the former in a shorter exterior claval vein, transverse venule between ulnar veins, and longer posterior pronotal process; from the latter also in the absence of several cellules. It differs from *Brachycentrotus* and *Monobelus* in the truncate base of the exterior discoidal cell of corium, and from the former in the much longer posterior pronotal process, 2 claval veins, and position of ocelli, but has the extended clypeus. Dedicated to Dr. Guy A. K. Marshall.

To include this genus in the "Classification," on page 301, between "61(64)" and "62(63)" insert

"*a.* Pronotum unarmed above humerals............MARSHALLELLA, Godg.
aa. Pronotum cornute above each humeral."

Marshallella rubripes new species.

Creamy-white, head and dorsum black, legs and spot on base of tegmina bright scarlet. Head shining black, rugose, with a slight median carina, uneven, with short pale hairs. Pronotum convex, unarmed, coarsely punctured and sculptured, creamy-white with dorsum shining black from near base to a point on base of posterior process, extreme tip of apex piceous; humerals prominent. Scutellum piceous, sides punctured. Abdomen sordid piceous above sides pale clouded, margins of segments, ventral surface, and large lateral valves, pale yellow, ovipositor piceous. Tegmina clear hyaline, veins piceous and punctate, a short narrow yellow stripe and a large scarlet spot near bases; legs bright scarlet, claws ferruginous.

Type, ♀, long. cum teg. 8.5 mm., to apex pronotum 7 mm.; lat. inter hum. 3.5 mm.; 6 paratypes similar in size and markings, one with tip concolorous creamy-white. The type and 5

paratypes in the British Museum, No. 1275; one paratype in my collection; all females.

Habitat: Cinchona, Jamaica (Gowdey).

Subfamily SMILIINÆ

Phormophora spreta new species.

Grayish-yellow without spots, base and lateral margins of pronotum toward apex narrowly, the punctures, and head, piceous; basal half of corium and 2d, 3d, and 4th apical cells opaque-brown, translucent; front and middle legs pale yellow, hind legs orange-yellow, tips of tarsi piceous.

Type, ♂, long. cum teg. 3.5 mm.; lat. 1 mm.; in the British Museum, No. 579½.

Habitat: Mona, Jamaica, (Gowdey).

It differs from *maura* and *dorsata* of Fabricius, the only species placed in this genus, in being smaller, ground color not black, and without spots.

THE REARING OF PINK KATY-DIDS

By Wm. T. Davis

Staten Island, N. Y.

Among the Long-horned Grasshoppers or Tettigoniidæ, the writer has observed pink individuals only in the genus *Amblycorypha,* the most common member of which in the State of New York is the Oblong-winged Katy-did. In the same genus brownish or straw-colored individuals also occur, as they do among other local species belonging to the genera *Neoconocephalus, Orchelimum* and *Conocephalus.* In *Microcentrum rhombifolium,* the Angled-winged Katy-did; *Peterophylla camellifolia,* the so-called "True Katy-did," as well as in *Scudderia,* only green individuals have been observed by the writer.

In the summer of 1924, four pink Katy-dids, belonging to the species *Amblycorypha oblongifolia* (De Geer), were brought to the museum of the Staten Island Institute of Arts and Sciences, and later recorded in the Proceedings of the Institute, Vol. 3, p. 109. They were found either in the Clove Valley, or at West New Brighton, in which general locality pink Katy-dids seem to be most commonly met with on Staten Island.

The female specimen collected September 1 lived until September 15 and was fed willow leaves. On September 13 she shed one of her hind legs. The female collected on September 16 lived in a terrarium until October 1, 1924, and had an abundance of food, eating the leaves of young grape-fruit trees, of honey-locust, and of a *Sedum.* She was seen to lay eggs in the ground. If confined in a glass jar the female tries to lay her flat, white eggs in the glass at the bottom of the jar. Failing in this, she deposits them on any leaf lying at the bottom of the jar.

The year 1925 passed and the eggs laid by the above-mentioned pink Katy-did were almost forgotten. The terrarium stood as usual on a window sill, and while the temperature in the room during the winters of 1924–25 and 1925–26 was often cool, it at no time went below freezing, so the eggs did not experience

the low temperatures which they would naturally have received if laid out of doors.

The terrarium was not tightly covered, and so when the young Katy-dids appeared in the latter part of May, 1926, some of them probably escaped before they were discovered. A pink male, a pink female, and a green male were secured, each of them either pink or green from the time of birth. They had been feeding on some sorrel (*Rumex*) that had come up in the terrarium, but were transferred to golden-rod, certain species of which seem to be among the favorite food plants of *Amblycorypha.*

On July 8 the green male matured, followed by the pink female on July 16. On July 17 the green male sang a few times. On July 20 the pink male matured. It may be noted at this point that just before reaching maturity and acquiring the dark-colored song-apparatus at the base of the tegmina, which latter also are often spotted, that a pink *Amblycorypha* is one of the most beautifully and surprisingly colored of our native insects. It is also one of the most conspicuous, and may be seen afar. It is the reverse of protectively colored, while green individuals of the same species, owing to their protective color, are not easily seen.

On August 2 the three mature insects were placed on exhibition in the Public Museum, where they attracted considerable attention, and sang quite often. The insects sometimes rocked to and fro on their legs, which indeed seemed to be quite unsteady. While an abundance of fresh golden-rod was supplied, the treatment of exhibition life did not agree with the insects, and on August 6 the pink female shed a hind leg, always a sign of weakness in *Amblycorypha.* On August 15, the green male shed a hind leg. On August 16 the pink male was found dead, and it was noted that he had lost three legs, though both hind legs were present. August 17 the green male died. On August 19 the pink female shed a hind leg, and on August 22 she likewise died.

A male *Amblycorypha oblongifolia* was collected at Richmond Valley, Staten Island, August 29, 1926, in which the tegmina were straw-colored, while the head, pronotum, and basal portions of the femora were green. No such bi-colored individuals have been found among the considerable number of pink *oblongifolia* observed; they have been of an all-pink color except for the darker spots on the tegmina and the dark areas about the song

apparatus. As with a number of Homoptera that are usually green, *Gyphona octomaculata* Say has a pink variety, often very brightly colored, and also quite often there are individuals partly green and partly pink in color, differing in this respect from the pink forms of *Amblycorypha*.

The literature relating to pink *Amblycorypha* has become rather extensive. In *Psyche* 2, 1878, 189, Scudder recorded "A Cardinal Grasshopper." In the same journal for 1897, he mentions other pink specimens, and in *Entomological News*, May, 1901, he has a further account, accompanied by a plate showing the beautiful coloring of these insects when alive. This plate was reproduced by Blatchley in his "Orthoptera of Indiana," 1902. In Dr. Lutz's "Field Book of Insects" a pink *oblongifolia* is also shown.

In the *American Naturalist*, 1907, Prof. Wm. Morton Wheeler has a more extended paper on the subject of "Pink Insect Mutants,"* and the various opinions concerning them. Finally in *Entomological News* for February, 1916, Dr. Joseph L. Hancock published his paper on "Pink Katy-Dids and the Inheritance of Pink Coloration."

The pink *Amblycorypha* that Dr. Hancock crossed with a green male laid eggs in 1912, which were subjected to out-of-door conditions and hatched in 1914 and 1915. In 1914 he had ten young *oblongifolia* (eight pink and two green), and in 1915 three (two green and one pink) from the original eggs laid in 1912, the sexes being about evenly divided in both the pink and the green forms.

Under date of December 1, 1918, Dr. Hancock wrote requesting data on all pink, tan or yellow colored Katy-dids, as he had in preparation another paper on the subject. I was able to send him records of eighteen such examples in *Amblycorypha*, including that of a pink male nymph of *Amblycorypha floridana floridana* found at Citrus Center, Florida, May 2, 1912. I believe the pink phase has not heretofore been noted in *floridana*. Dr. Hancock died in Chicago, March 12, 1922, before he had published the paper referred to.

* In THE JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY for March, 1925, the writer has added records of pink or pinkish individuals among cicadas in *Pacarina puella* and *Melampsalta calliope*.

The record here given seems to be the second one of the rearing of pink Katy-dids from the eggs, and the observations on the leg-shedding habit may be of interest. It has generally been supposed when an *Amblycorypha* was found with a missing leg or two, as often happened, that such loss was the result of an accident rather than an actual shedding of the limbs. Probably both causes contribute to the conditions as we find them. It may be added that many species of Orthoptera, including *Amblycorypha oblongifolia*, if subjected to the fumes of tetrachloride of carbon, will be observed to tremble spasmodically, after which the hind legs become disengaged from the body.

Also the postponement of the hatching of the eggs to the second year after they were laid, without having gone through the freezing conditions of out of doors, would seem to be of interest.

DESCRIPTION OF A NEW RACE OF PAMPHILA JUBA SCUDDER (LEPIDOPTERA—RHO-PALOCERA—HESPERIIDAE)

By E. L. Bell

Flushing, N. Y.

Pamphila juba, race **dodgei** new race.

Smaller than typical *juba*, in both sexes. The upper side with a darker shade of fulvous and very broad black borders, into which the fulvous does not cut so deeply along the veins, maculation otherwise similar, though variable as usual in the *comma* group. Beneath, primaries, dark chestnut brown in apical area and outer margin, extensive, much reducing the fulvous area; secondaries, chestnut brown, usually very dark, entirely lacking the yellowish or greenish-yellow overscaling of *juba*; slightly paler between the band of white spots and the outer margin; with or without a pale brown or fulvous-brown area along the inner margin as far as vein 1 or a little beyond; the band of white spots on the under side of the secondaries, which is so well marked in *juba*, is in both sexes of the race *dodgei* extremely variable, it may be complete, with all the spots well marked, but not so large, or with those below the two spots at the angle of the band, very much reduced or entirely absent; the usual basal spots are present. Fringes of both wings darker than in *juba*.

Described from 45 specimens from Santa Cruz, California, August 9 to September 26.

Holotype, male, August 15, 1926; allotype, female, August 29, 1926; deposited in the collection of the American Museum of Natural History, New York City.

Paratypes, 20 males and 23 females, distributed as follows: 10 males and 9 females in collection of Mr. J. D. Gunder, Pasadena, California; 3 males and 6 females in collection of Dr. William Barnes, Decatur, Illinois; 3 males and 6 females in collection of Mr. E. A. Dodge, Santa Cruz, California; 1 male in collection of Dr. A. W. Lindsey, Granville, Ohio; 3 males and 2 females in collection of the author.

It is with great pleasure that this race is named for Mr. E. A. Dodge, of Santa Cruz, California, to whom belongs the credit for its discovery.

Dodgei is easily separated from *juba,* or any other member of the *comma* group; the peculiar shade of brown of the under side of the secondaries, without overscaling of any other color, is very distinctive; it may well be taken for a distinct species, which indeed further biological studies may prove to be the case; the form of the male genitalia, while similar, is a little different from that of *juba.*

A female among those in the collection of Mr. Dodge is aberrant in that the small spot in interspace 7, of the band on the under side of the secondaries, is prolonged and fused with the basal spot in the same interspace, thereby producing a long white bar, which shows a small dot of the ground color at about its center.

The author is much indebted to Mr. J. D. Gunder for the loan of his fine series of specimens, from which the types were selected; to Dr. William Barnes and Dr. F. H. Benjamin for the use of the specimens in Dr. Barnes' collection; and to Mr. E. A. Dodge for the use of his specimens.

All of the specimens known to the author have come from Santa Cruz, California. Mr. Dodge has written that it is found only near the seashore and that it is usually rare; it may be that it is restricted to that particular locality, though further collecting may turn it up at other points along the coast.

A NEW GENUS AND SPECIES OF DYTISCIDAE

BY H. C. FALL

TYNGSBORO, MASS.

About four years ago, in connection with a "Review of the North American Species of Agabus," the writer published a description of a remarkable new genus and species of the same tribe under the name *Carrhydrus crassipes.* The unique type was a male, and it now seems desirable to announce that I have since detected the female in a small sending of Dytiscidæ from Mr. F. S. Carr, who collected the original male. This female specimen was returned to Mr. Carr, who has deposited it in the Canadian National Collection at Ottawa. It closely resembles the male superficially, and agrees with it in the peculiar form of the penultimate joint of the labial palpus, but of course lacks the extraordinary secondary sexual characters of the male type.

This past summer (1926) I have again received an interesting new dytiscid of more than average size, represented as before by a single male specimen, and again requiring the erection of a new genus for its reception.

Hoperius new genus.

Oval, depressed, facies rather like that of *Hydaticus* but less convex. Antennæ and palpi as in *Colymbetes* and *Scutopterus* but slightly more slender. Prothorax strongly margined at sides; elytra coarsely reticulate and with the usual rows of finely setigerous punctures. Prosternum broadly convex at summit, gradually pointed behind the coxæ, not at all deflexed apically; metasternal wings triangular; coxal plates distant somewhat less than half their length from the middle coxal cavities; metasternum deeply grooved for the reception of the strongly produced prosternal process; sculpture of body beneath as in *Colymbetes* and *Scutopterus.* Hind femora without setigerous punctures at apex; pro- and mesotibiæ elongate triangular, finely punctate, the latter with some coarse punctures externally; metatibiæ with marginal and discal rows of coarse punctures; protarsi of male rather narrowly dilated and somewhat compressed, fourth joint scarcely wider than the fifth and but little narrower than the third; beneath, joints one (apically) to three clothed with glandular hairs tipped with elongate palettes; mesotarsi feebly dilated and similarly clothed beneath; joints of hind tarsi

only slightly lobed at tip; front and middle claws slender, evenly curved, and equal; hind claws very unequal, the shorter bent at tip.

This species seems quite certainly to belong to the Colymbetes Group of the Colymbetini, although I have been unable to examine the side pieces of the first dorsal abdominal segment. The coarsely reticulate elytra would here associate it with *Scutopterus,* which is at once separable by its unmargined thorax, the presence of a group of setigerous punctures at the apex of the hind femora (totally lacking in *Hoperius*) and several other differences of more or less importance.

Hoperius planatus new species.

Moderately elongate oval, depressed, outline continuous; piceous, head in front and prothorax at sides (more widely) becoming gradually rufotestaceous, elytra with abruptly defined dull yellowish external margin; surface shining throughout and scarcely detectably alutaceous at any part. Head quadripunctate and with a minute punctulation. Prothorax three times as wide as long, sides evenly broadly arcuate, disk minutely punctulate and with short longitudinal scratches near the rear margin, sides with irregular scratches, which near the margins form closed reticulations. Elytra reticulate throughout, the meshes rather large and very irregular in form, a few scattered punctures within the meshes. Prothorax beneath, epipleura and legs dull rufotestaceous, the hind legs somewhat darker. Length 12.8 mm.; width 6.7 mm.

A single male specimen from Hope, Arkansas, bearing date VI–11–26, sent me by Miss Louise Knobel, and taken I believe at light.

A NEW ARRANGEMENT AND A NEW GENERIC NAME IN THE GORTYNID SERIES OF THE ACRONYCTINAE (LEPIDOPTERA)

BY HENRY BIRD

RYE, N. Y.

Whatever the preference of authors in the nomenclatorial buffeting about which has befallen the gortynid series of genera, of the Acronyctinæ, there are certain satisfying natural affinities that appease inquiries into their relationship. Of outstanding prominence in this phylogenetic complex is a certain line whose ancestry goes back to a boring, grass-feeding, larval habit, that together with other special characteristics give stress to an individual branch whence several lateral off-shoots have arisen. The existing representatives of this early type are scattered through the North Temperate Zone and their boring larvæ yet cling to grasses so far as known. Unlike the usual diaphanous, boring larva these, in their early stages particularly, show types of coloration whereby they may be readily placed. A peculiar, ringed coloration has developed with some and these connect with a second likewise ringed larval form that has forsaken the grasses, yet bore in the higher herbaceous plants. From this category a European off-shoot gains what is admittedly generic rank through a clypeal development in the adult, with its larva still perpetuating the peculiar ringed markings.

In the North American fauna, a numerous and for the most part a compact group acknowledges relationship to this ancestral stock through one species at least, in its ringed larva, but as an entirety they exhibit many exclusive larval and adult phases. Two score of their early-stage larvæ may be recognized at glance by whitish longitudinal markings on a dark background, with a preponderance of the species having the lines broken midway so as to exhibit a characteristic, girdled appearance. A Pacific Coast species, through a clypeal modification of the adult, must be set apart, though in every other respect it belongs with the

major series. Still more distantly related is an eastern species which cannot be associated in the other groups.

Taking these categories as they stand in the later lists, we have the genera *Apamea, Gortyna, Xanthoecia* (or *Ochria,* if Hubner's name be allowed), *Papaipema, Emboloecia,* and one previously considered under *Xanthoecia* but which cannot be so continued in the light of these phylogenetic concepts. This has to do with the species *buffaloensis* Grt., whose larva mines the stem and extensive rootstock of *Saururus cernuus,* in the eastern United States, from southern Canada to Florida.

Grote,[1] in the knowledge of his time, was inclined to consider all this gathering, with the exception of those adults with frontal development, as best treated under the single genus *Gortyna,* and it may be convenient to yet speak of them collectively as the gortynid series. Later writers made much of the thoracic tufting as a taxonomic detail, and Smith[2] in addition pointed out the advantages arising from a genitalic study of the males. Of venational characters, there seems nothing distinctive. Since Smith's work, a fuller perspective of genitalic details illuminate certain departures. With *Apamea,* an anomaly arises; in the *nictitans* group, having five Eurasian and three North American forms, their genitalic details readily separate them into as many well distinct species, yet the moths seem to show only ordinary varietal differences, and until more is known of their larvæ, their standing may be optional. With *Papaipema* mainly, a genitalic type arises which has a certain generic status, even though in many cases specific differentiation is unconvincing in this organ alone. Throughout the series, however, genitalic comparisons aid greatly. With those adults having frontal development, the pupæ show this configuration, excepting *sauzalitæ* Grt., and in one *Papaipema* instance, *maritima* with a smooth frons, has a pupal prominence over the thoracic tuft, but which would inferentially suggest a clypeal protuberance.

In weighing this sum of evidence for the series, the advantage arises that for more than half the number of species their larvæ are known, and since larvæ in their earliest stages unquestionably

[1] Proc. Amer. Philos. Soc., Vol. XXXIX, No. 162. 1900.

[2] Trans. Amer. Ent. Soc., Vol. XXVI, May, 1899.

point back to the ancestral types, their value here becomes obvious and of the first importance.

Hampson,[3] 1910, proposed the generic term *Xanthoecia*, with the European *flavago* as type, and included our eastern *buffaloensis*. He erected *Emboloecia* at the same time to receive our western *sauzalitæ*, since its frontal armature was much different —a vertical, keel-like ridge. Excepting this feature the latter species is typically a *Papaipema*; its genitalia conform to that genus exactly; the adult is superficially similar; the imperfectly known larva seems to agree and the pupa appears to be that of a species having a smooth frons. In position, *Emboloecia* must certainly stand contiguous to *Papaipema*. The species *flavago*, with its ringed larva and similar genitalia, is close to the *micacea-immanis* section of *Gortyna*, and should have such placement. *Buffaloensis* is clearly not congeneric with *flavago*, nor with *sauzalitæ*, when all the evidence is weighed. The frontal protuberance is individual; its larva in striped coloration and setal arrangement exhibits a form near *Papaipema*, yet not of it. The genitalia are even more individual and altogether the species has nowhere a position in the gortynid series, except as a separate genus. Because it links in an unbroken chain to the ancestral type the following name is proposed.

Genus **Parapamea** nov.

Genotype; *P. buffaloensis* Grt.

ADULT: Tongue normal; eyes round; palpi upturned, second joint with moderate vestiture and arising to middle of frons; antennæ ciliate; frons armed with a small, reduced thorn-like point; thorax heavily clothed, the moderate, prothoracic tuft arises behind the prominent collar and is composed of long hair-like scales, the metathorax has a lesser and divided crest; body covered with short scales; hind tibia with two pairs of equal, stout spines. Forewing not broad, slightly produced at apex; vein 3 and 5 from near the angle of cell. Hind wing with veins 3 and 4 from the lower and 6 and 7 from the upper angle of cell, 8 joints to the cell near the base. The male genitalia are without striking characters; uncus a single curved arm; valve uniformly broad, rounded at costa with a lobe protruding at the ventral end, not set with heavy spines; from the medial area the free, somewhat trigonate clasper arises, having smooth edges.

LARVA: Cylindric, longitudinally striped; tubercles large and in full complement; with mining habit.

[3] Cat. Lepid. Phal. Brit. Mus., Vol. IX, p. 32.

PUPA: Somewhat elongate, cylindrical, the frons plainly showing its tuberculate nature, with a pair of sharp anal spines.

The three genera with frontal armature separate as follows:

1. Frons having a vertical ridge drawn out to a point; forewing bright yellow; larva ringed, tubercle I exceeding II..*Xanthoecia*
2. Frons having a keel-like ridge; forewing yellowish; larva with tubercles I and II equal..*Emboloecia*
3. Frons having minute, conical, sharp, central point; forewing purplish; larva striped, tubercles III on abdominal joint eleven of exceeding prominence ....*Parapamea*

Employing the generic terms in the sense of the Barnes & McDunnough List, 1917, the Gortynid series should receive the following placement:

Apamea
Gortyna
Xanthoecia
Papaipema
Emboloecia
Parapamea

It is particularly argued that there be no interpolation of other genera in this series. *Achatodes, Brachyxanthia, Rhodoecia, Pyrrhia, Calloecia, Eurythroecia* and *Copifrontia* can in no way break in on the natural affinities of the gortynid group.

The occasion is opportune to note that *Papaipema erubescens* Bird,[4] 1911, whose larva bores a tomentose thistle, *Cirsiun occidentale,* at San Francisco, Cal., is the same as *Emboloecia sauzalitæ* Grt., 1875. Dr. F. H. Benjamin called my attention to the fact that *erubescens* possessed a modified frons and the specimens of *sauzalitæ* now in collections affirm the individuality of the two. When *erubescens* was proposed, so far as the writer knew, the British Museum type of the Grote species was unique, and the holotype is much redder and richer than a drawing of that type appeared. *Sauzalitæ* proves to be a variable species and the term *erubescens* might be retained with propriety for this more rosy form. There is yet another form in which the normal white stigmata are suppressed, or appear only concolorous.

The frontal ridge is not definitely indicated in the pupa, but shows prominently when the frons of the adult is denuded.

[4] Can. Ent., Vol. XLIII, p. 37.

REVISION OF THE MEMBRACIDAE OF SOUTH AMERICA AND ANTILLES

By FREDERIC W. GODING

This revision has been prepared to include in their modern genera all forms in the several subfamilies of the Membracidæ reported from the territory indicated, and so far as possible clear up the synonymy. As the colors depend upon the degree of maturity, and the size, shape and direction—sometimes even the presence or absence—of the pronotal protuberances vary in a number of species, they are not to be entirely depended upon in classification, while the venation of the tegmina and wings is a much safer guide, although their combined use will be found to be the best practice. However, eventually the most reliable characters will be taken from the sexual apparatus.

Single examples or a long series of many species have been examined, practically every published figure, as well as special drawings of a number of Walker's types made by Mr. W. E. China, of the British Museum, in which the important characters were delineated, were studied. Also most of the publications on the Membracidæ are on the shelves of my library.

A complete bibliography of the genera and species will be found in Dr. W. D. Funkhouser's monumental "Catalog of the Membracidæ," while his valued opinion on a number of puzzling species was freely given.

My thanks are due to Dr. F. X. Williams for the hundreds of examples placed in my hands of South American species; to Profs. Francisco Campos R., and Clodoveo Carrion, Messrs. G. H. H. Tate, and E. Feyer for much Ecuadorian material. Dr. L. O. Howard kindly forwarded copies of descriptions from works not in my library, and Miss Ruth Olsen made copies of a number of papers.

I. Subfamily ÆTHALIONINÆ

Genus STICTODEPSA

Stal, Hem. Fabr. ii, p. 57 (1869).

One fusco-ferruginous punctured species, head and metopidium darker, tibiæ and tarsi yellowish-ferruginous; head more than one-half shorter than pronotum .... *fuscata* Fabr.

fuscata, Fabr. S. Rh. p. 21; Stal, l. c. p. 57. S. Am.

Genus SCYTODEPSA

Stal, l. c., p. 57.

KEY TO SPECIES

1(2). Small; pronotum fusco-ferruginous, densely punctured, head and chest black; tegmina clear .... *exigua* Fabr.

2(1). Larger; pronotum ochraceous, finely punctate, head and chest concolorous; exterior half of corium opaque black, interior half and broad band at bases apical cells clear hyaline........................ *magna* Godg.

LIST OF SPECIES

exigua, Fabr. l. c. p. 23; Stal, l. c. p. 57. S. Am.

magna, Godg. T. A. E. Soc. iii, p. 104. Napo R., Ecuad.

Genus ÆTHALION

Latrielle, Gen. Ord. Nat. Anim., p. 263 (1810).

KEY TO SPECIES

1(14). Sides of prostethium with an obtuse ruga between front angles and posterior lobe, more or less distinct or obsolete.

2(11). Tegmina unicolorous, black, testaceous, or yellowish, apices sometimes lightly fuscous dotted.

3(10). Veins of tegmina pale at least behind middle.

4 (9). Pronotum destitute of black stripes.

5 (8). Pronotum flat anteriorly, barely convex.

6 (7). Basal margin of head lightly sinuate; ground color yellow or testaceous .... *reticulatum* Linn.

7 (6). Basal margin of head straight; pronotum black, margins and median carina white, a broad ferruginous stripe each side, hind margins, stripe near base, black; abdomen yellow, dorsal stripe and basal and apical marks, black .... *apicale* Walk.

8 (5). Pronotum convexo-declivous anteriorly........................ var. *albo-nervosum* Sign.

9 (4). Pronotum with black stripes, convexo-declivous anteriorly. var. *multicolor* Sign.

10 (3). Veins of tegmina concolorous or pale toward base, tegmina subrugose; pronotum densely punctate, testaceous to blackish or ferruginous with black stripes .... *variabilis* Stal.

11 (2). Tegmina not unicolorous.

12(13). Basal margin of head straight; pronotum shining black, punctate, median carina, short stripe each side, lateral margins anteriorly, yellow; tegmina red, an irregular black stripe from base each side, veins mostly yellow .... *picta* Godg.

13(12). Basal margin of head lightly sinuate; pronotum reddish-yellow, median carina and stripe each side black; basal half tegmina

pale, impicted, apical half darker veins pale, cells fuscous margined .... *basale* Walk.

14 (1). Sides of prostethium with a distinct carina between front angles and posterior lobe.

15(20). Carina on sides of prostethium not foliaceously flattened; tegmina rugulose.

16(17). Pronotum and bases of tegmina remotely black-punctured; veins of apical half of tegmina black; head comparatively narrow, eyes not prominent beyond front angles of pronotum, basal margin straight .... *parviceps* Sign.

17(16). Pronotum and bases of tegmina densely punctured, punctures concolorous yellow; head about as wide as pronotum, eyes prominent beyond front angles of pronotum, basal margin sinuate.

18(19). Basal margin of head broadly sinuate at middle, sides of sinus rounded; pronotum yellow, no black stripes; tegmina and abdomen blackish .... *latreillei* Sign.

19(18). Basal margin of head distinctly sinuate at middle, an angle each side of sinus the tips rounded; pronotum black, finely punctate, margins yellow; abdomen black .... *nigrum* Sign.

20(15). Carina on sides of prostethium foliaceously flattened.

21(24). Basal margin of head straight or slightly sinuate at middle; pronotum convexo-declivous anteriorly.

22(23). Head about as wide as pronotum, basal margin straight, eyes prominent beyond front angles of pronotum; pronotum brown with dark spots on testaceous veins of tegmina, head and pronotum.
nervoso-punctatum Sign.

23(22). Head proportionately narrow, eyes not prominent beyond front angles of pronotum, basal margin sinuate at middle; pronotum distinctly punctate, testaceous, and it with scutellum immaculate; tegmina concolorous .... *quadratum* Fowl.

24(21). Basal margin of head deeply emarginate at middle, each side of sinus produced in a prominent angle or triangular horn; carina each side of prostethium elevated, frequently foliaceously flattened. (Subgenus Schizia, Lap.)

25(28). Scutellum lightly convex, not gibbous.

26(27). Carina each side of prostethium sinuate anteriorly; pronotum reddish-yellow with darker stripes .... *servillei* Lap.

27(26). Carina each side of prostethium roundly flattened out; pronotum greenish-yellow with yellow stripes; tegmina green, veins black and testaceous .... *gratum* Walk.

28(25). Scutellum distinctly gibbous anteriorly; pronotum testaceous.

29(30). Pronotum not densely punctured, punctures black; tegmina opaque, bases black punctured .... *punctatum* Walk.

30(29). Pronotum densely punctured, punctures concolorous; tegmina yellow hyaline, bases punctured .... *fissum* Walk.

LIST OF SPECIES

reticulatum, Linn. S. N. 12, p. 707; Fowl. B. C-A. Hom. ii, p. 171, pl. 10, f. 18.
minuta, Fabr. E. S., iv, p. 26.
citrona, Stoll, Cig., p. 59, pl. 14, f. 74.
parallelum, Sign. A. E. S. Fr. 2, ix, p. 677.
bivittatum, Walk. List, p. 649.
var. *albo-nervosum,* Blanch. V. d'O. vi, pp. 221, pl. 31, f. 6.
simile, Sign. l. c., p. 674.
vicinum, Sign. l. c., p. 674.
var. *vitticollis,* Stal, B. M. K., p. 297; Fowl. l. c., 171, pl. 10, f. 19.
var. *multicolor,* Sign. l. c., p. 676, pl. 14, f. 7.
Costa Rica; Pan.; Jamaica; Colomb.; Venez.; B. Guiana; D. Guiana; Braz.; Chile; Boliv.; Ecuad.
apicale, Walk. l. c., p. 648. Braz; Colomb.
semi-annulatum, Sign. l. c., p. 673.
variabilis, Stal, l. c., p. 297. Colomb.
picta, Godg. l. c., p. lii, p. 105. Ecuad.
basale, Walk., l. c., p. 647. Colomb.
subfascia, Walk. l. c., Suppl., p. 168.
parviceps, Sign., l. c., p. 671, pl. 14, f. 6. Chile; Venez.
latreilei, Sign. l. c., p. 672. Chile.
var. *unicolor,* Sign., l. c., p. 672.
nigrum, Sign. l. c., p. 677. Braz.
nervoso-punctatum, Sign. l. c., p. 679, pl. 14, f. 10. Mex; Ecuad.
var. *minor,* Fowl., l. c., p. 172, pl. 10, ff. 20–21.
quadratum, Fowl. l. c., p. 172, pl. 10, f. 22. Pan; Fla.
Polydontoscelis cinctifrons, Ashm. Psyche, viii, p. 327.
servillei, Lap. A. E. S. Fr. 1, p. 224, pl. 6, f. 3. Braz.
var. *hilare,* Walk., l. c., Suppl., p. 169.
gratum, Walk. l. c., Suppl. p. 169. Mex; Guat; Pan.
dilatatum, Stal, Ent. Zeit., xxv, p. 73.
punctatum, Walk. l. c., p. 646. Colomb.
curvatum, Sign., l. c., p. 678, pl. 14, f. 9.
pulchrum, Walk., l. c., p. 647.
fissum, Walk. l. c., p. 648. Colomb; Braz.
servillei, Sign., l. c., p. 678, pl. 14, f. 8.

Genus TROPIDASPIS

Stal, Hem. Fabr., ii, p. 55.

KEY TO SPECIES

1(2). Small; yellow to ferruginous, chest, abdomen and basal third of tegmina concolorous; basal sulcus of head broad, shallow, exterior angles not prominent; dorsum pronotum moderately convex, median carina slightly elevated; apical margins tegmina oblique.
truncaticornis Stoll

2(1). Larger; fuscous-brown, chest, head below vertex, two short lines on metopodium, tips of denticulated exterior angles of vertex, and basal fourth of tegmina, black; sulcus at base of vertex narrow, deep, exterior angles produced in prominent denticles; dorsum pronotum very tumid, median carina foliaceously elevated at middle; apical margins tegmina rounded .... *jubata* Godg.

LIST OF SPECIES

truncaticornis, Stoll, Cig. p. 115, pl. 28, f. 169. D. and B. Guiana; Pan.
carinatus, Fabr. Syst. Rh., p. 21.
jubata, Godg. l. c., p. 104. Tena, Ecuad.

Genus NICOMIA

Stal, O. V. A. F., p. 249.

KEY TO SPECIES

1(4). Tegmina hyaline with black bands; pronotum yellowish or testaceous.
2(3). Punctures on pronotum concolorous, a ferruginous or blackish mark each side of metopidium, sometimes divided; scutellum concolorous; tegmina with basal and median bands, a small streak near tips, and body below, blackish .... *obliqua* Walk.
3(2). Punctures on pronotum fuscous, median carina, impressed mark each side of metopidium, blackish; scutellum blackish at base; tegmina with bands front of middle, the chest, and disk of venter, blackish .... *interrupta* Stal
4(1). Tegmina clear hyaline, veins black, immaculate; pronotum yellowish.
5(6). Chest black, yellow spot each side anteriorly; abdomen black, a yellow basal band; scutellum with black dorsal stripe; pronotum minutely punctured, median carina, mark each side on metopidium, point each side posteriorly, black .... *cicadoides* Walk.
6(5). Chest sordid yellow, abdomen concolorous; base of scutellum reddish testaceous; pronotum densely punctate, with numerous black stripes. *lemniscata* Stal

LIST OF SPECIES

obliqua, Walk. ♀, l c., Suppl. p. 341 (March, 1858). Venez.; Braz.
subfasciata, Stal, ♂, l. c., p. 249 (May 12, 1858).
interrupta, Stal, l. c., p. 249. Braz.
cicadoides, Walk. Jour. Ent. i, p. 317. Braz.
lemniscata, Stal, l. c., p. 249. Braz.

Genus ENDOASTUS

Fowl., l. c., p. 168.
One uniformly brown or ferruginous species .... *caviceps* Fowl.

LIST OF SPECIES

caviceps, Fowl. l. c., p. 168, pl. 10, f. 16. Guat.; C. R.; B. Guiana.
productus, Osb. Zool., iii, p. 233.

Genus Mina

Walk., List Suppl., p. 165.

KEY TO SPECIES

1(2). Black, scutellar horn not hirsute; broad band and exterior border of tegmina black .... *aliena* Walk.

2(1). Dark ochreous, pilose; scutellar horn long, slender, erect, very hirsute; brown band near tips tegmina .... *stylata* Buckt.

LIST OF SPECIES

aliena, Walk. l. c., p. 165. Ega, Braz.

stylata, Buckt. Mon. Memb. p. 212, pl. 47, f. 5. Amazons, Braz.

Genus Lophyraspis

Stal, Hem. Fabr., ii, p. 55.

KEY TO SPECIES

1(2). Pronotum fuscous with an acute median carina, obsolete anteriorly; scutellum with an elevated rounded crest, front fuscous, white behind; tegmina destitute of fuscous bands.................. *scutellata* Fabr.

2(1). Pronotum destitute of median carina, with an obsolete median line; tegmina with fuscous band.

3(4). Median carina of scutellum elevated in a nearly erect fuscous crest, pale posteriorly; abbreviated band behind middle, apical spot and apical margin of corium, and base of clavus, bronze-black.
vittata Oliv.

4(3). Median carina of the scutellum acute posteriorly, not crested; pronotum black or ferruginous; base, transverse band at middle, and large subapical spot exteriorly, brown .... *parvimusca* Stoll

LIST OF SPECIES

vittata, Oliv. Enc. Meth. vii, p. 762. S. Am.
  muscaria, Fabr. S. Rh., p. 44.

parvimosca, Stoll, l. c., p. 63, pl. 15, f. 82. D. and B. Guiana; Ven.
  pygmaea, Fabr., l. c., p. 44.

scutellata, Fabr. l. c., p. 44. S. Am.

Genus Gerridius

Fowl., B. C.–A. Hom., ii, p. 165.

One pitchy black species has been taken in South America, with a band on head, and hind margin of pronotum, testaceous, with an obsolete median line; scutellum black, hind margin white; tegmina black spotted.
scutellatus Fowl.

Baker described another form from Niacaragua (Can. Ent., xxxix, p. 114), which differs from the type form in the shorter tegmina and 3d apical cell, named *G. abbreviatus*.

LIST OF SPECIES

scutellatus, Fowl. l. c., p. 166, pl. 10, f. 11. Pan; B. Guiana; Ecuador.
  fowleri, Havil. Zool., vi, p. 261.

Genus EUSTOLLIA

Goding, T. A. E. Soc., lii, p. 105.

KEY TO SPECIES

1(2). Dorsum of scutellum straight, median carina lightly elevated; pronotal elevation slightly inclined forward, not broad, hind margin oblique, pronotum piceous; tegmina brown, opaque, with or without black bands and red spots .... *jubata* Stoll

2(1). Dorsum of scutellum sinuate, base gibbous; tegmina opaque, destitute of bands or spots, veins irrorate.

3(4). Pronotal elevation lightly inclined forward, base and tip seen from side subequally broad, front margin lightly sinuate, hind margin and summit truncate, yellow testaceous golden pubescence; apex scutellum flat; venation of tegmina indistinct toward base, apical two-thirds distinct .... *punctata* M. & B.

4(3). Pronotal elevation well inclined forward, base much broader than summit seen from side, superior and posterior margins continuously convex, front margin strongly sinuate; scutellum narrow, median carina compresso-elevated before apex; tegmina with bases, costal and claval margins, punctate, venation distinct, surface greenish yellow mottled with black and brown .... *cornuta* Havil.

LIST OF SPECIES

jubata, Stoll, l. c., p. 37, pl. 7, f. 34. D. Guiana.

punctata, M. & B., Bul. B. E. Soc. xx, p. 213, pl. 1, f. 18, 19, 20. Cuba.

cornuta, Havil. l. c., p. 261, pl. 5, f. 1. B. Guiana.

Genus LAMPROPTERA

Germar, Rev. Ent. Silb., iii, p. 261.

KEY TO SPECIES

1(4). Summit of scutellar horn rounded, nearly truncate; pronotum black; tegmina hyaline with black bands.

2(3). Pronotal horn slightly inclined forward, summit rounded; scutellar horn erect, summit distant; tegmina with 3 black bands.
capreolus Germ.

3(2). Pronotal horn recurved, summit touching scutellar horn which is inclined forward; tegmina hyaline, base, short band on interior posterior angle, and claval suture, black .... *vacca* Germ.

4(1). Summits of both dorsal horns acute, recurved, distant; pronotum black or ferruginous; tegmina hyaline, with a central brown spot.
cristata Stal

LIST OF SPECIES

capriolus, Germ. Mag. Ent. iv, p. 33, pl. 1, f. 4; Fairm. Rev. Memb. p. 528, pl. 3, f. 11, 12. Braz.

vacca, Germ. l. c., p. 34; Fairm. pl. 1, f. 10. Braz.

cristata, Stal, Hem. Fabr. ii, p. 56. B. Guiana.

Genus TOLANIA

Stal, Ent. Bid., p. 248.

KEY TO SPECIES

1(14). Apex of scutellum obtusely rounded.
2 (7). Pronotum ferruginous to black.
3 (6). Covered with gray pubescence.
4 (5). Tegmina fusco-hyaline, costa and apical margins black; front margin of suprahumerals carinate .... *obscura* Germ.
5 (4). Tegmina hyaline, base fusco-ferruginous, suprahumerals not carinate .... *semipellucida* Stal
6 (3). Destitute of pubescence; tegmina dark yellow, fuscous costa and base punctate .... *scutata* Stal
7 (2). Pronotum yellowish, or variegated.
8 (9). Base of scutellum turgid; suprahumerals crestiform; tegmina yellow hyaline, base ferruginous, punctate; chest and femora in ♂ black, in ♀ yellow .... *cristata* Leth.
9 (8). Scutellum flat.
10(11). Abdomen blackish, pale laterally; pronotum with black lines anteriorly; tegmina fuscous, tips pale .... *felina* Germ.
11(10). Abdomen yellow.
12(13). Body hairy; pronotum black variegated, metopidium almost perpendicular; scutellum black, with a furrow and basal yellow stripe; tegmina tawny, with a broad median black band; abdomen with a broad black dorsal band .... *fasciata* Walk.
13(12). Body not hairy; scutellum with sordid yellowish stripe; tegmina tawny, base fuscous and costa punctate, no black band. *fraterna* Stal
14 (1). Apex of scutellum acute.
15(16). Pronotum black, depressed; scutellum slender, a yellow and a white spot on base; tegmina gray, lurid toward tips........ *humilis* Walk.
16(15). Pronotum yellowish, with black marks anteriorly.
17(18). Suprahumerals erect; body below and legs bright yellow; tegmina yellow hyaline, costa black .... *armata* Stoll
18(17). Suprahumerals divergent, slightly curved, black above; scutellum black, base testaceous, slender; tegmina lurid; abdomen black; legs with black streaks .... *opponens* Walk.

LIST OF SPECIES

obscura, Germ. Rev. Ent. Silb. iii, p. 258. Braz.
semipellucida, Stal, Ent. Bid. p. 249. Braz.
scutata, Stal, ♂, Hem. Rio J. ii, p. 36. Braz; B. Guiana.
cristata, Leth. A. E. S. Fr. (1890), p. 155. Venez.
femoralis, Stal, ♀, l. c., p. 37.
felina, Germ. l. c., p. 259. Braz.
fasciata, Walk. List, p. 1147. Braz.

fraterna, Stal, l. c., p. 37. Guat; Pan; Pearl Is; Venez; Braz.
obtusa, Fowl., l. c., p. 166, pl. 10, f. 14.
humilis, Walk. l. c., Suppl. p. 161. Braz.
armata, Stoll, l. c., p. 90, pl. 24, f. 130. D. Guiana.
opponens, Walk. l. c., Suppl. p. 159; Fowl. l. c., pl. 10, f. 12, 13; Buckt. 1 c., pl. 60, f. 4. Mex; Guat; Pan; Braz.
fasciata, Walk., l. c., Suppl., p. 161.

Genus WILLIAMSIANA

Goding, T. A. E. Soc., lii, p. 103.

One ferruginous species, densely punctured on pronotum, scutellum, and tegmina; suprahumerals short, stout, conical; base of head horizontal; tegmina green, opaque, venation ferruginous red; wings reddish hyaline, veins red, long as tegmina and broader at basal third .... *ferruginosa* Godg.

ferruginosa, Godg. l. c., p. 103, fig. in text. Baños, Ecuador.

Schmidt opines (in lit.) that it belongs to Breddin's genus *Zyzzogedon*, of the Tettigoniellidæ.

Genus ABELUS

Stål, Bid. Memb. K., p. 293.

KEY TO SPECIES

1(2). Black, sparingly golden pubescent; pronotum densely and distinctly destitute of stripes; apical half of tegmina fuscous, base black, a decolored spot behind costa and clavus .... *luctuosus* Stal
2(1). Ferruginous; pronotum with 2 broad fuscous stripes; tegmina hyaline, a fuscous discal spot each side anteriorly and one behind apex of clavus, base ferruginous, veins testaceous......................... *inermis* Leth.

LIST OF SPECIES

luctuosus, Stal, Bid. Memb. K., p. 294. Bogota, Colomb.
inermis, Leth. A. S. E. Fr. (1890), p. 155. Tovar, Venez.

FOUR ENCYCLOPEDIC ENTOMOLOGISTS OF THE RENAISSANCE

BY HARRY B. WEISS
NEW BRUNSWICK, N. J.

When poppy heads and chamomile hung from the ceilings of drug stores, when Sir Francis Drake and Magellan were navigating the globe, when vagabonds in England were lashed for the first offense, branded on the ear for the second and sentenced to death for the third, when Copernicus was undermining Ptolemy's theory of the heavens and founding modern astronomy, when demonology, chiromancy, necromancy and astrology flourished, when heretics and sorcerers were burned and traitors were hung, drawn and quartered, when Galen's anatomy was being supplanted by scientific discoveries, when the bubonic plague raged in some part of Europe every year, when luxury and filth traveled conjointly, when Shakespeare's plays, dicing and bear-baiting were fashionable, when Paracelsus was getting his wisdom directly from God, when barbers performed small operations while the surgeons gnashed their teeth, when *Lues venera* was so prevalent that it was regarded as an epidemic and when every nation was blaming its origin on another, when Galileo was making discoveries in mechanics and Gilbert in magnetism, when Luther was attacking the Pope and the medieval Church was being partially disrupted, when architecture, sculpture and painting reached a high development, when seditious words meant the loss of both ears, when Rabelais was spanking everybody and everything in sight, when Mary was burning Protestants and Elizabeth was slaughtering Catholic priests, when thinking people were turning from metaphysics to observation and experimentation, and when "Margaret White, widow, who died at Bromley in 1538, by her will gave one hive of bees to support the light of All Hallows, and one hive to support the light of the sepulchre, and a third to the light of St. Anthony"[1]—when these

[1] Funeral customs by B. S. Puckle (New York, 1926).

things were happening in the Sixteenth Century, the entomologists at that time were, for the most part, repeating what the Greeks had written.

Four of them were outstanding figures on account of their encyclopedic activities at a time when such industriousness was highly thought of. In a strict sense they were not entomologists but naturalists because of their wider interests. Their books are now antiquated repertories of still more antiquated opinions, and as such are rarely if ever consulted.

Edward Wotton, said to have been the first student to formally classify Aristotle's animals and to introduce zoology into the list of studies required for a physician's training, was born at Oxford in 1492. His father, Richard Wotton, was bedel of the university and Edward was educated at Magdalen College, becoming a chorister in 1503, a demy in 1506, a bachelor of arts in 1513–14 and a fellow in 1516. John Claymond, author of a manuscript entitled "Notes and Observations on the Natural History of Pliny," and demy of Magdalen in 1483, took an interest in Edward Wotton and introduced him to Fox, founder of Corpus Christi College, who made him *Sociis compar* and in 1521 or 1523–4 gave him leave to travel in Italy to finish his studies and learn Greek. This Wotton did, spending most of his time at Padua where he graduated M.D. Upon his return to England he was admitted a fellow of the College of Physicians and became successively consiliarius, elect, censor, and president from 1541 to 1543. While he was a fellow at Magdalen he was accused with other fellows of arranging to elect special undergraduates to scholarship, but he apparently had the confidence of Fox, who afterward appointed him first reader in Greek at Corpus Christi.

As a physician Wotton attended the Duke of Norfolk, and Margaret Pole, Countess of Salisbury, who gave him an annuity of sixty shillings. He was interested mainly in zoology, especially classification, and when that portion of his work entitled "De Differentiis Animalium," dedicated to Edward VI, was printed at Paris in 1552, his reputation was considerably embellished. Gesner and Haller praised it as a complete and well-written digest of previous books on the subject, balancing this approbation, as reviewers are always doing, with another remark,

that it contained nothing new. Neander, however, said: "No one had written of animals more learnedly and elegantly than Wotton."[2]

Wotton collected material for a history of insects, but died before finishing it, and Thomas Penny and Thomas Moffett continued the work, but neither lived to see it printed. However, it was finally printed in London in 1634 by Theodore Mayerne, and in 1657 it appeared in English as an appendix to Topsell's "History of Four-footed Beasts and Serpents." Moffett in the preface states that he added more than 150 illustrations unknown to Gesner and Penny, and also made numerous changes and corrections. Moffett compiled it from the compilations of Wotton, Gesner and Penny. Wotton died October 5, 1555, and was buried in St. Alban's Church, Wood Street, Cheapside.

Conrad Gesner, sometimes called the Pliny of Germany, was more than an entomologist, and even more than a naturalist. In addition to his interest in botany, insects, higher animals, fossils, etc., he was a physician and a Greek scholar of high reputation. Haller described him as a "prodigy of knowledge"—"*monstrum eruditionis.*" He was born, of commonplace parents, in Zurich, March 26, 1516, and received his early education and some instruction in botany from his maternal uncle, a clergyman, who died when Conrad was quite young. When he was about fifteen, his father was killed while fighting with Zwingli, in the defense of Zurich against the Catholics, and when the small heritage left by his father was divided among the large family, practically nothing was left for Conrad.

He then went to Strasburg where he worked for Wolfgang Fabricius Capito, the Lutheran reformer and preacher, but upon receiving assistance from the canons of Zurich he went to Bourges and commenced the study of medicine. When he was eighteen he went to Paris, being supported by a Bernese nobleman named Steiger, but in 1536 he returned to Zurich and taught grammar, on a very low salary. Receiving an additional grant of money, the next year, from the magistrates, he then went to Basel to continue his medical education, and while there added to his income by helping the ecclesiastic Phavorinus, in editorial

[2] Explicatio Orbis Terrae, 1597.

work. Then to Lausanne, where he taught Greek for three years and then to Montpellier to study anatomy and botany. In 1541 he received his degree of M.D. at Basel, and then commenced the practice of medicine at Zurich. His later activities include travel and authorship.

His ''Bibliotheca Universalis'' is a bibliography of all authors in Latin, Greek and Hebrew, his ''Mithridates,'' ''an attempt to arrange all the languages of the world according to their affinities,'' and his ''Pandectæ Universales,'' an index to all book knowledge. His ''History of Animals,'' written in Latin, appeared from 1551 to 1587, and treated mammals, birds, fishes, etc. The volume on insects and serpents did not appear during Gesner's lifetime. This ''Historia Animalium,'' composed chiefly of extracts from Aristotle, Pliny, Ælian, etc., and his own observations, but without discrimination and order, was highly thought of. The entire work ran into some 4,500 folio pages and was illustrated by several hundred woodcuts. His botanical knowledge, as indicated by his letters and drawings of plants which were utilized by later botanists or publishers, was much sounder and points to considerable industry, botanical skill, and knowledge of affinities.

Gesner knew, corresponded with and helped many naturalists and scientific men of his time, including Belon, Aldrovandi, Caius, Turner, Valerius Cordus and Rondelet. Rondelet was the celebrated naturalist and professor of anatomy at Montpellier of whom it was said that he was such an ardent student of anatomy that he dissected after death one of his own children. This, however, may be an untrue account which found its way into print. However, Rondelet, a little corpulent man, was the physician ridiculed by Rabelais under the name Rondibilis, or roly-poly. It will be recalled that Pantagruel got together a theologian, a physician, a lawyer and a philosopher to advise Panurge in the matter of his ''nuptial enterprise'' and Rondibilis was the physician.

Gesner died December 13, 1565, of the plague. He was the public physician at the time and had taken an active part in the fight against the epidemic at Zurich the previous year. His library and manuscripts were bequeathed to Caspar Wolf. He

was survived by his wife, having married while teaching grammar at Zurich.

Another naturalist, physician, botanist and entomologist who paid more attention to the compositions of his predecessors than to nature was Ulysses Aldrovandi, scion of a noble family and wealthy. Born at Bologna in 1522, where he was later director of the botanic garden which he helped to found, he at first studied botany, medicine and other subjects, but later upon advice from Rondelet concentrated upon zoology and botany. He traveled extensively, collected material for his books, employed artists and carried his enthusiasm for natural history so far that he found himself in old age without funds for his support. Some accounts state that he died blind in the hospital at Bologna, May 4, 1605. Cuvier doubts that the senate of Bologna, to whom Aldrovandi willed his museum and manuscripts, would have allowed him to become destitute during his last years, but Macgillivray does not place such confidence in the senate of Bologna.

Aldrovandi did not begin to publish his treatise until late in life, and of the thirteen folio volumes of his works, only four, three on birds and one on insects, appeared during his lifetime. In 1606, his widow published a volume on the ''other white-blooded animals, including testacea and crabs.'' In 1613, his work on fishes and whales appeared, and in 1616 that on the quadrupeds with solid hoofs, both revised by Cornelius Uterverius, his successor in the institute at Bologna. In 1621, Thomas Dempster, also a professor at Bologna, edited the ''History of the Quadrupeds with Split Hoofs'' and Aldrovandi's other works were prepared for publication by Ovid Montalbanus and Bartholomew Ambrosinus, the latter being professor of botany at Bologna and a successful practitioner of medicine. Cuvier said that Aldrovandi's work represented ''an enormous compilation without taste or genius.''

His work on insects, ''De Animalibus Insectis,'' edition of 1638, is a folio of 767 pages, with quite a few illustrations, some of them full page. It contains an extensive list of authors who are cited, and some of the insect accounts are very short and others, as the one on the Cantharis, extend over sixteen or seventeen pages. The accounts include what the ancients thought,

histories of the species, names in various languages, proverbs, medical uses, historical allusions, etc.

John Jonston, another encyclopedist, is characterized by Miall as "a weak successor to Aldrovandi, from whom he borrowed largely." He was born 1603 at Sambter, near Lissa in Poland, and after studying at Beuthen on the Oder, at Thorn, and at St. Andrew's, he returned to his native home and tutored the sons of Count Kurtzbach for three years. He then studied medicine and natural history at various institutions at home and abroad, obtaining his degree of M.D. at Leyden. In 1632, he accompanied two young noblemen on a tour to England, Holland, France and Italy and then settled in the vicinity of Lignitz.

In 1632 his "Thaumatographia Naturalis in Decem Classes Distincta" was printed at Amsterdam. This is a collection of the "most curious phenomena presented by the sky, the elements, meteors, fossils, plants, birds, quadrupeds, insects and the man." Another of his works, a "Dendrographia," was devoted to shrubs. His most important work, however, was "Historia Animalium," published at Frankfort. The first part, containing a total of nine books on fishes, cetacea and white-blooded aquatic animals, came out in 1649; the second part, on birds, in 1650; the third, on quadrupeds, in 1652, and the fourth, on insects and serpents, in 1653. Although the work was, for the most part, a compilation from Gesner, Aldrovandi and others, it was quite popular and was republished and translated several times, the last edition being that of Heidelberg, 1755. Jonston died June 8, 1675.

Although the erudition of the encyclopedists continued to be republished, the next century with its lenses and microscopes saw the beginnings of descriptive morphology, of better classification and even of experimentation, as shown by the work of such investigators as Malpighi, Hooke, Ray, Leeuwenhoek, Swammerdam and Redi.

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Title Page of 1638 Edition of Aldrovandus

414 Vlyſſis Aldrouandi

Locuſtas eſſe putem. Hanc cùm Cyprio oſtēderem, Bruchum vocabat, quod non probo. Numero 9. ex Attelaborum genere dici poteſt, propter alarū breuitatē. Hæ enim, aluo, quæ admodū craſſa eſt, comparatæ, inutiles eſſe vidētur, impotentes ſcilicet eam de terra attollere. Cucullum quoq; habet, eumq; viridem, reliquo toto corpore ex viridi, albo, flauo, & nigro varia. Decima inſigni, ac notabili aculeo ſurſum reflexo, viridi, inſignis, ex vulgariū genere eſt, ſed differens plurimùm colore. Tota aluo, & dorſo coloris eſt amethiſtini, ſiue violacei, roſtro viridi, fronte, cucullo, & antēnis, quæ proceræ ſunt, ac exiles, coloris ochræ, pedibus poſterioribus viridibus. Alis caret, Bruchus adhuc ac imperfecta Locuſta. Vndecimo, & poſtremo numero Locuſta, ſeu Attacus cinereus linea in vertice, & dorſo ferruginea, alis exterioribus nigro, & cinereo varijs, cruribus poſtremis in femore interno, & infimis tibijs phœnicco ſuauè rubentibus, & maculis atris in rubeo colore, & poplitibus diſtinctis.

Tertia

Page 414 of the 1638 Edition of Aldrovandus

THEATRUM
UNIVERSALE OMNIUM
ANIMALIUM
PISCIUM, AVIUM, QUADRUPEDUM,
EXANGUIUM, AQUATICORUM, INSECTORUM,
ET ANGIUM,

CCLX. *TABULIS ORNATUM,*

Ex Scriptoribus tam antiquis quam recentioribus

ARISTOTELE, THEOPHRASTO, DIOSCORIDE, ÆLIANO, OPPIANO, PLINIO, GESNERO, ALDROVANDO, WOTTONIO, TURNERO, MOUFFETO, AGRICOLA, BOETIO, BACCIO, RUVEO, SCHONFELDIO, FREGIO, MATHIOLO, TABERNOMONTANO, BAUHINO XIMENE, BUSTAMANTIO, RONDELETIO, BELLONIO, CÆSIO, THEVETO, MARGRAVIO, PISONE, & aliis maxima curâ à J. JONSTONIO collectum,

Ac plus quam Trecentis Piscibus & Animalibus

Nuperrime ex INDIIS ORIENTALIBUS allatis,

Ac nunquam antea his terris visis, locupletatum; cum Enumeratione morborum, quibus medicamina ex his Animalibus petuntur, ac Notitiâ Animalium, ex quibus vicissim Remedia præstantissima possunt capi; cura

HENRICI RUYSCH M. D. Amstelæd.

VI. PARTIBUS COMPREHENSUM.

TOMUS II.

AMSTELÆDAMI,

Prostat apud R. & G. WETSTENIOS,

MDCCXVIII.

Title Page of the 1718 Edition of Jonston's "Theatrum Animalium"

Plate VII of the 1718 Edition of Jonston's "Theatrum Animalium"

INSECTS AS PRECURSORS OF THE PLAGUE

With so much superstition connected with the plague, and with outbreaks regularly taking place every ten or twenty years from the fourteenth to the seventeenth centuries, it is no wonder that people were continually looking for the signs that preceded such attacks and interpreting various happenings as forerunners of the events. In addition to certain positions of the planets, the appearance of comets, earthquakes, eclipses of the sun and moon, floods, heavy fogs, volcanic eruptions, shooting stars, tempests, the failure of crops, etc., outbreaks of insects also, were looked upon as precursors of the plague.

Cowan[1] cites Paulus Orosius as authority for the statement that, "In the year of the world 3800, . . . such infinite myriads of locusts were blown from the coast of Africa into the sea and drowned, that being cast upon the shore in immense heaps, they emitted a stench greater than could have been produced by the carcasses of one hundred thousand men. A general pestilence of all living creatures followed. And so great was this plague in Numidia, where Micipsa was king, that eighty thousand persons died; and on the sea-coast, near Carthage and Utica, about two hundred thousand were reported to have perished." Kirby and Spence[2] mention St. Augustine as saying that a plague arose in Africa from the same cause, resulting in the deaths of some 800,000 persons in the kingdom of Masanissa. And there are other records of the plague following invasions of locusts (and famine caused by the locusts) in France, Italy, Spain, Poland, Germany, etc. It was thought that the plague was due to the stench arising from the rotting bodies of the millions of grasshoppers.

In 1346, locusts and white mice announced the plague in Germany, and, "In 1478 the whole of Latin Europe was plagued by locusts which devastated everything, gardens, meadows and fields, after which a great epidemic came into the land, and in Venice alone there died more than 300,000 persons." Additional por-

[1] Curious Facts in the History of Insects, Phila., 1865.

[2] Introduction to Entomology, London, 1859.

tents were, "Unusual insects, strange worms, big-bellied toads, unknown frogs with tails with which the medical men of the period were not familiar, large quantities of all kinds of beetles, large, black vineyard moths, large spiders, gnats 'of uncanny shape and color.' "[3] When fruit and legumes became wormy, when the webs of spiders were unusually plentiful in the woods and when insects were observed on the snow, and when many other things happened--they were all thought to be signs of an approaching epidemic, so apprehensive were the people at that time.

Abraham a Santa-Clara (1681), writing of the plague in Vienna, mentions various signs that precede an outbreak and says, "Earth signs are unusual lack of fertility of the soil and failure of the crops of trees, the fields, and the vineyards, also the earthquakes; further when in the autumn the spring flowers and herbs once more grow green and flower, when the multitude of locusts, beetles, vineyard moths and mice devour the fruit of the earth everywhere."

Although it was not until 1894 that the plague bacillus was discovered, Father Kircher's writings (1659), as reported by Johannes Ammianus in 1667, hint at a bacterial origin. "Thus he writes that the plague is nothing but a multitude of small animals and diminutive worms which fly about in the air, and when drawn into the body by the action of breathing they vitiate the blood, impair the spirits, and finally gnaw into the flesh and glands. When they fly from an infected body, or, in some other manner, are received by a healthy subject, the plague is spread by them. Protection against them could be obtained by lighting large and flaming fires by means of which their wings, feet, or probosces, etc., are burnt off, so that they can no longer fly about and vitiate the blood of human beings and gnaw their bodies." Johann Georg Nicolai Dietrich (1714) thought that Kircher was making fun of Hippocrates and his method of setting fire to forests in order to burn the wings of "plague insects," but other physicians supported Kircher's views and some held that the contagious matter was confined to the air surrounding the patients.

3 The Black Death by J. Nohl (translated by C. H. Clarke, London, 1926).

It is now known that the bubonic form of the plague is, in most cases, transmitted by the flea. The pneumonic form, a less important type, is spread without any interagent and during coughing, plague bacilli are expelled into the air.—H. B. WEISS.

PIERRE EUGENE DU SIMITIERE, EARLY NATURALIST

Mr. Alexander Stuart Graham has recently called my attention to a paper by Mr. William John Potts, entitled "Du Simitiere, Artist, Antiquary, and Naturalist, Projector of the First American Museum, with Some Extracts from His Notebook," which was printed in the *Pennsylvania Magazine of History and Biography,* Vol. XIII, No. 3, Oct., 1889, pp. 341–375. Born in Geneva, Du Simitiere visited the West Indies about 1750 and collected botanical specimens, coins, shells, and made water-color drawings for ten years. He arrived in New York about 1764 or 1765 and then went to Burlington, N. J., and finally to Philadelphia in 1766. He was a member and one of the curators of the American Philosophical Society and during the Revolution he drew the portraits of many distinguished men of that time. His "American Museum" was located on Arch Street, above Fourth, in Philadelphia, and contained collections of "books, engravings, water-color sketches, coins, fossils, Indian relics and general antiquities." It is stated that this museum antedated Peale's Museum and that Du Simitiere's pictures, Indian relics and natural history specimens formed the basis of Peale's Museum.—H. B. WEISS.

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

Meeting of March 2, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M. in the American Museum of Natural History, President Dr. Frank E. Lutz in the chair, with twenty-three members and thirteen visitors present.

The curator reported the Society's need of a stereopticon owing to the increased number of illustrated addresses and the inconvenience of borrowing for such occasions.

Miss Madeleine Seydel, 86 Haven Ave., New York, was elected a member of the Society.

Dr. Lutz explained the necessity of closing meetings promptly at 10 P. M. The museum is open on Tuesday evenings until 9:30 P. M. for meetings in the auditorium during the lecture season and is therefore lighted by the main engine, which also lights the Society's room. The prolongation of meetings beyond even 9:30 P. M. requires the continued operation of this engine at considerable expense to the museum which, up to 10 P. M., is permitted. After the close of the lecture season, the Academy Room, lighted by the donkey engine, is the only place available; and if meetings are prolonged beyond 10 P. M. it will be necessary to hold them in that room.

On motion by Mr. Olsen the Executive Committee was authorized to purchase a stereopticon as suggested by the curator for a sum not exceeding $100.

Mr. Wm. T. Davis exhibited twelve types and eight allotypes of North American cicadas described by him, to be placed for safe keeping in the collection of the American Museum of Natural History. The species were as follows: *Tibicen apache,* and *semicincta; Okanagana magnifica, mariposa, nigrodorsata, bella, bella* var. *rubrocaudata, nigriviridis, oregona, triangulata, balli, rubrorenosa.*

Mr. Shoemaker exhibited "A few interesting Ornithoptera Butterflies from New Guinea." The species shown were *supremus, chomaera, victoriæ, arruana, lydius,* and *goliath,* the latter differing, however, in some respects from typical. Mr. Shoemaker gave the individual history of each specimen.

Mr. Herbert Johnson spoke of "Domestic Insects in China" and of collecting conditions there. He referred briefly to the silk industry as carried on in Soochow and at more length to the Chinese passion for song birds and insects, so that the collection and caging of cicadas, crickets and katydid-like Orthoptera has become a regular business. Passing to collecting conditions Mr. Johnson showed, with about forty stereopticon slides, the conditions as he had found them during his stay in China. Agricultural industry

has completely obliterated forests near Soochow, but narrow strips of trees and shrubs occur along canal banks and on some roads. Private gardens afford good collecting, and temple gardens even better, especially when lotus ponds are included. Cemeteries were also found useful at times. Many interesting scenes in the narrow streets of Soochow were shown, especially of its canals, which the speaker compared with those of Venice. Mr. Johnson's business brought him into contact with the China Medical Board and one of its problems, the human manure basins or pots and manure boats, which are rinsed and ply upon the canals in which clothes are washed and from which water for cooking is obtained.

Mr. Johnson, Dr. Leonard present as a visitor, and several members joined in a discussion of the silk industry and of the superb silk exhibit in preparation at the museum.

Mr. Olsen and Mr. Ragot described insect cages used in Spain and in Mexico.

Mr. Dow, referring to Mr. Johnson's account of cricket fighting in Soochow, described the mantis fights staged by Chinese in Southern California.

Dr. Sturtevant spoke on "Sex Determination in Insects," with blackboard diagrams illustrating the following points: There are three distinct types of sex-determination by chromosomes among the insects.

A. The female has two similar "X" chromosomes, the male has only one "X." Each sex has two complete and similar sets of all other chromosomes. This type occurs in the Orthoptera, Corrodentia, Heteroptera, Odonata, Coleoptera, Diptera, and in most cases Homoptera.

B. The male has two similar "Z" chromosomes, the female has only one "Z." Each sex has two complete sets of all other chromosomes. Here the sperm are all alike (with Z); the eggs are of two kinds (half with Z, half without it). In the first type, on the other hand, the eggs are all of one kind but the sperm are of two kinds. This second type of sex determination occurs only in the Lepidoptera among the insects.

C. The female has two complete sets of chromosomes, the male has only one set. The male always exists by parthenogenesis, and fertilized eggs always produce females; but in some forms unfertilized eggs may fail to halve their number of chromosomes and thus come to produce females. This type occurs in the Thysanoptera and Hymenoptera, and in the family Aleurodidæ among the Homoptera.

Mr. Dow humorously described his vain efforts to collect cicadas that might prove to be rare or new, stating that he had heard 80,000,000 without being able to see one.

MEETING OF MARCH 16, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M. on March 16, 1926, in the American Museum of Natural History, President Dr. Frank E. Lutz in the chair, with twenty-eight members and twelve visitors present.

Mr. Shoemaker, for the Field Committee, reported an outing arranged for April 4 to Roselle Park.

Mr. Hall, for the Executive Committee, reported the purchase of a stereopticon, as authorized by the Society, for $37.50.

On motion by Mr. Angell, the thanks of the Society were tendered to Mr. Hall, and the treasurer was authorized to repay him.

Mr. E. B. Chapin, 134 John Street, Hackensack, N. J., and Dr. J. G. Gehring, Bethel, Maine, were elected members of the Society.

Mr. Watson exhibited a part of the "Butterflies donated to the American Museum of Natural History by Mr. Frank Johnson," including *Coscinocera hercules, Rhescyntis morti, Papilio alexandræ, P. antennor, Agrias aedon, Prepona omphala, P. præneste.*

Dr. Melander spoke, with lantern slide illustrations, of "Insect Collecting on Mt. Rainier," which he had visited seven times. These visits had often been hampered by rain and immense snow falls, for which the mountain is famous. But during the short growing season, from June 15 to September 1, its alpine flora afford the best of collecting. About 100 slides were used to show these flowers and the insects that were attracted by them. The insects represented many orders, Diptera predominating in Dr. Melander's selection, which was said to aggregate twenty-four boxes with about 3,000 specimens in each. Many pictures were shown also of the scenery above and below the tree line, the glaciers and the desolate stone piles that result from its action.

His remarks were discussed by several members and all greatly enjoyed his account of this remarkable mountain.

Mr. Frank Johnson exhibited a gigantic moth, *Actias mittrei,* from Madagascar.

MEETING OF APRIL 6, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M. on April 6, 1926, in the American Museum of Natural History, President Dr. Frank E. Lutz in the chair, with twenty-two members and four visitors present.

Mr. Angell reported for the Outing Committee a trip to Cedarhurst, L. I., on April 18; and an expedition to Roanoke Island, N. C.

Prof. A. L. Melander was elected a member of the Society.

Mr. Barber exhibited a copy of the "Naturalists' Guide to the Americas."

Mr. Angell presented Mr. Davis with a new slingshot for the further destruction of cicadas.

An invitation to attend annual meeting of the Riverdale Entomological Society was read and the Society commended by President Lutz.

Mr. Davis exhibited the "Report of the British National Committee on Entomological Nomenclature" with a letter from Dr. K. Jordan asking for criticism.

Dr. Lutz objected at once to Section III of Article 23, by the operation of which an upheaval of nomenclature would become possible.

Mr. Angell exhibited a case illustrating the life history of *Lucanus cervus.*

Mr. Olsen, under the title "Miscellaneous Notes on Cicadellidæ," read a

translation of an obituary of Dr. Bergroth; and exhibited a number of pamphlets relating to the family, praising especially the monographic study of *Deltocephalus* by Dr. Long. Two papers on the Jassidæ of Kansas by S. E. Crumb were interesting as having been overlooked by Van Duzee. Mr. Olsen closed with an account of a recent visit to Ithaca and of his inspection of the collection of Cornell University.

The Comstock method of pinning insects on blocks of wood was discussed by Mr. Barber, Mr. Davis and Dr. Lutz, who said that as improved in the United States National Museum, it had such advantages that it had been adopted for gall insects in the American Museum of Natural History.

Mr. Bird delighted the Society with a story of ''The Entomological Ignis Fatuus of the Dismal Swamp, Virginia,'' in which the adventures of Mr. Frank Morton Jones and himself in the swamp were described, and coupled with their efforts to secure for Harry G. Barber and Herbert S. Barber *Saldoidea slossonæ,* reputed by Mrs. Annie Trumbull Slosson to occur on mossy logs. A calculation of the number of mossy logs to be examined in the 1,000 square miles of swamp finally decided them to leave these 3 mm. long shore bugs in peace, sitting on their mossy logs beckoning to their respective Barbers.

Mr. Angell exhibited a deformed *Lucanus cervus.*

Mr. Davis presented a pamphlet in Spanish on grasshoppers and their economic importance.

Meeting of April 20, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M. in the American Museum of Natural History, President Dr. Frank E. Lutz in the chair, with twenty-two members and sixteen visitors present.

Mr. Shoemaker reported the next outing to Hewlett, L. I.

The Decoration Day outing was discussed.

Mr. Davis exhibited the ''Check List of Lepidoptera'' by Barnes and Benjamin; he also read W. J. Chamberlin's announcement of the ''Buprestidæ of North America.''

Mr. Sheridan spoke of the new School of Microscopy.

Prof. Alexander Petrunkevitch spoke of ''Spider Life in Guadeloupe and Porto Rico'' with illustrations by stereopticon views. His account of Guadeloupe and its volcanic mountains, its tremendous profusion of vegetation, and colorful rocks clothed with mosses and lichens, made many members wish to go there in spite of the absence of toilets and paucity of spiders. His stay in Porto Rico was longer, from September 10 to February 1, and yielded interesting results in the study of tarantulas. Dr. Petrunkevitch's account of the wasp *Pepsis marginata* attacking huge spiders will be printed in full.

In the discussion of poisonous spiders which followed, Mr. Davis and Dr. Lutz both spoke of *Latrodectus mactans* as occurring in New Jersey.

MEETING OF MAY 4, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M. on May 4, 1926, in the American Museum of Natural History, President Frank E. Lutz in the chair, with twenty-eight members and five visitors present.

Mr. Leng exhibited the compilation, by Dr. W. Horn, of Berlin, of the resting place of the entomological collections of the world.

Mr. Shannon, under the title "Do Diptera Migrate?" spoke first of the movements of insects, capable of interpretation as migratory, recorded in literature, going back to 1100 A. D. and giving rise to superstitious fear. He then spoke of his own observations since 1915 at Long Beach, Far Rockaway, Norton's Point, on Long Island, and Longport in New Jersey, establishing determinate movements of *Anosia plexippus, Anax junius,* and other butterflies and dragon flies southward in autumn. For Diptera he had observed fifty such autumnal flights since 1915.

In answer to Dr. Felt he said that he was unwilling to make comparison with bird migration or to advance any theory as to the cause. He was, however, convinced by repeated observation that the movements described were seasonal, not accidental, and not clearly dependent upon wind.

In the discussion which followed, Dr. Felt gave numerous recorded instances of extraordinary insect movements due entirely to wind drift, one in particular involving 100,000 aphids carried by wind to Spitzbergen. Mr. Davis recalled the long continued observations of Mrs. Slosson on Mt. Washington; Mr. Bird the northward drift of flocks of cotton moth; and Dr. Lutz the occasional drift of *Erebus odora* from the tropics to Canada.

Mr. Swift, however, described movements of butterflies observed at Panama, involving journeys north and south for sixty miles, and Mr. Shannon added similar occurrences in Florida.

Dr. Lutz stated that the American Museum had planned to investigate the subject as far as *Anosia plexippus* was concerned; but the failure of the butterfly for the last two years to move in large flocks had prevented carrying it out.

Mr. Swift gave an interesting account of the "Relationship between Xyleborus Beetles and the Die-back of Mature Cacao Trees," showing that these trees, always liable to injuries from machetes, were subject to a canker disease, causing a sudden death of the tree when the canker had girdled it. The Xyleborus beetles breed in the dying wood, entering the tree through its wounds, and multiply rapidly within the tree. Though they are not the primary cause of the "Die-back," they do spread the spores of the canker which is the cause. The remedy is to burn the trees affected before they have become so dead as to allow the colony of beetles to leave them for other trees.

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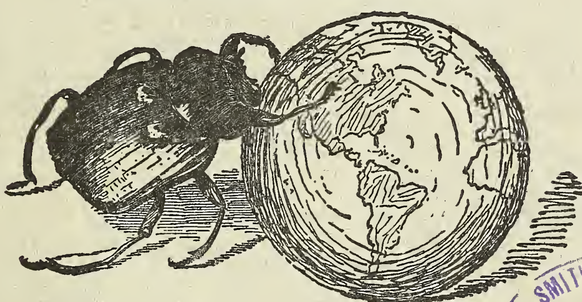
NEW YORK ENTOMOLOGICAL SOCIETY

Devoted to Entomology in General



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STUDIES ON CHEMICAL CHANGES DURING THE LIFE CYCLE OF THE TENT CATERPILLAR (MALACOSOMA AMERICANA FAB.), III. SOLUBLE ASH AND SULFATES*

By Willem Rudolfs

Biochemist, New Jersey Agricultural Experiment Station

Introduction

The composition of insect tissues in terms of fats, carbohydrates and proteins takes into consideration the cells and the products stored in them. Fats are usually stored and may be used either as energy for metamorphic processes or at certain times in the life cycle for maintenance of life processes. Carbohydrates are essential for tissue building and can be used as energy during metamorphosis. The proteins are perhaps most important of the three, since the cells consist mainly of protein materials, and are therefore essential to the growth of the insect, but ordinarily they are not stored for future use.

The decomposition of these different materials (fats, carbohydrates, nitrogenous matter) gives rise to certain waste products, like carbon dioxide, carbonates, sulfates, etc. Gross measurements of these waste products gives a clue to the actual relation between the destruction of the different components, whereas the determination of changes in the amounts of waste products dur-

* Paper No. 352, Journal Series of the New Jersey Agricultural Experiment Station. Department of Entomology.

ing the life cycle of an insect furnishes data for the interpretation of physiological activities.

This is especially the case when the different stages of development of the insect are compared.

The determination of changes in the amounts of soluble ash (mainly carbonates and sulfates) during the life cycle of the tent caterpillar enables us to determine the sources of energy used during each stage since these waste products will fluctuate and change their relative relation whenever one group of substances is used at a greater rate than the other.

Changes in the carbohydrate contents of the insect may be determined by gross determinations of crude fiber, sugars, etc., but it was thought that indications of the decomposition of carbohydrates, including carbon material from decomposed fats, could be obtained by analyzing the ash for carbonate contents. This reasoning assumes that increased activities (increased carbon dioxide production) would also increase the amounts of acid and true carbonates. If no changes in carbonates would occur, particularly during that part of the life cycle when the larvæ are confined to the egg cases, this reasoning obviously would be incorrect. If changes did occur the interesting question is still to be answered whether the changes are in all cases directly in proportion to the CO_2 output of the insect, but since no attempt will be made in this paper to determine accurately the total amounts of carbonaceous materials used, but rather which substances were used predominately during certain stages, this question can be left for the future. However, the fact that carbonates fluctuated tends to show that measurements of CO_2 output (a measurement commonly employed for energy transformation in insects) which do not take into consideration the accumulation of carbonates are inaccurate.

The object of determining carbonates in the ash content was not only to find possible changes, but also to determine whether or not these carbonates remained, whether their relation to total ash and sulfate content was constant in the different stages of development, and how they changed with the changes in moisture, fat and nitrogen contents of the insect.

Nitrogenous substances (proteins) used in the metabolic processes contain certain quantities of sulfur. Many of the proteins have sulfur largely in the form of cysteine and some in the form of cystine or possibly both. This organic sulfur is excreted largely in the form of inorganic sulfate (in human beings from 75 per cent. to 80 per cent. of the total sulfur of the urine is in the form of inorganic sulfates) and determinations of sulfates would throw some light upon protein decomposition, especially in larvæ confined to egg cases.

Methods and Material

The material used has previously been described (1). Total ash was determined by incineration of 5 to 10 grams dry material. Soluble ash was determined by treating the ash with

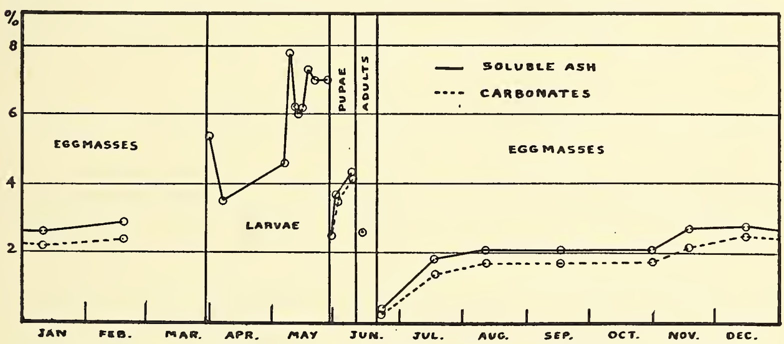

FIG. 1. Percentage soluble ash and carbonates present on a dry basis during the different stages of the life cycle of tent caterpillars.

strong HCl and HNO_3; carbonates by treating ash with dilute sulfuric acid, heating, collecting the gases and determining the CO_2 content of the gas. Sulfates were determined in the usual manner by precipitation with barium chloride. All results were calculated on a dry basis.

Results

Analysis of soluble ash (mainly carbonates) is graphically shown in figure 1. The analyses show that the soluble ash of the egg masses increased rapidly after the eggs were deposited and the larvæ were formed. It remained practically constant during

the winter months until shortly before hatching. The soluble ash content of the growing larvæ increased markedly and the same was true for the pupæ. It is evident that every time a new phase of the life cycle started the soluble ash content was lowest, increasing as time went on. It is of interest to place on record that the non-soluble ash contained a substance which behaved like a sodium silicate (glass). Upon heating the material would liquefy, and become hard when cooled. The amounts of this material did not increase with the age of the egg masses and was present and increased rapidly in the growing caterpillar. A quantity of this material is still on hand but has not been analyzed further. It is conceivable that certain ingredients of this substance play a rôle in the maintenance of moisture content by the insect.

At the time of deposition of the egg masses (June) the soluble ash content was 0.41 per cent., increasing in 26 days to 1.85 per cent. In February this content had increased to 2.90 per cent. and the larvæ, collected when hatched, contained 5.46 per cent. soluble ash. Five days after hatching the percentage was 3.52 while the soluble ash content reached its maximum (7.37 per cent.) at the time when the rate of growth of the caterpillar was greatest. It dropped somewhat when they were full grown and ready to pupate. During the pupal stage a persistent increase took place. Considering the comparatively short time (12 days) between the stage when the caterpillars became flabby (ready to pupate) and ready to hatch, an increase from 2.54 per cent. to 4.33 per cent. or a percentage increase of 58.6 is quite remarkable. It seems to explain why the relative fat content of the pupæ increased. Only 10 per cent. of the total fat present was used during the processes of reconstruction; the balance was stored. This brings us to the question, where did the soluble ash increase come from, or in other words what material was used mainly in the processes of reconstruction? The answer will be clearer when, in a next paper, the results on glycogen are presented.

The changes in sulfate content of insects during the different stages of their life cycle are presented in figure 2, expressed in parts per million dry matter. The freshly laid egg masses con-

tained 1600 p.p.m. sulfates. The sulfate content increased rapidly during the period of formation of the larvæ, remained for a time practically constant, and increased again during the latter part of the stage of confinement in the egg cases. During the larval stage (when they were actively feeding) the sulfate content fluctuated but reached a lower level than at the time when the larvæ were still in the egg masses. The sulfate content of the pupæ and adults was comparatively very low. As has been pointed out above, nearly all proteins contain sulfur in small

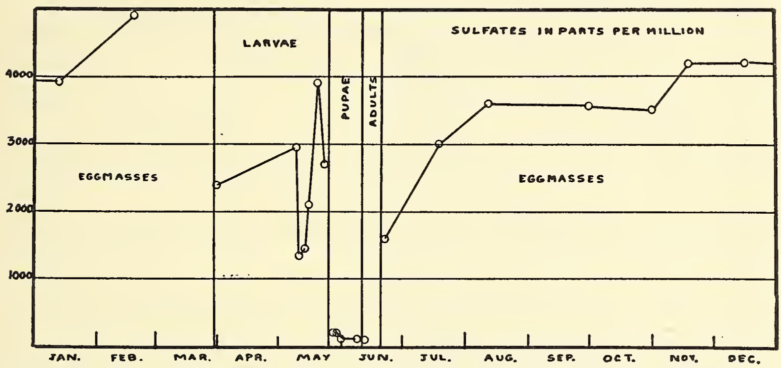

FIG. 2. Parts per million sulfates present on a dry basis in tent caterpillars.

amounts. This sulfur is oxidized and secreted, but the larvæ in the egg cases must deposit these sulfates in the egg cases. It is natural that the sulfates increased rapidly when the small larvæ were forming, if we assume that protein material was changed to amino-acids and the sulfur oxidized.

In a former publication (1) it was stated that part of the nitrogen present in the larvæ ready for pupation was lost during the metamorphosis, and that during the period of "just pupated" to "ready to hatch" the nitrogen did not decrease, but that the fatty substances decreased materially, and the conclusion was drawn that during this period metabolic processes necessary for the maintenance of life were continued at the cost of fatty substances. The low sulfate figures obtained during this period support this conclusion. At the same time the carbonate content of the ash increased during this period giving further evidence.

To enable a somewhat better understanding of the groups of materials which are utilized during the different stages of development, we have plotted in figure 3 the nitrogen-sulfate ratios and the carbonates-sulfate ratios. Keeping the nitrogen constant we see at once that during active larval growth the sulfates are produced at a faster rate than nitrogen accumulates. As soon as the larvæ stop feeding (ready for pupation) the relation is reversed. Since the larvæ in the egg cases had no access to food

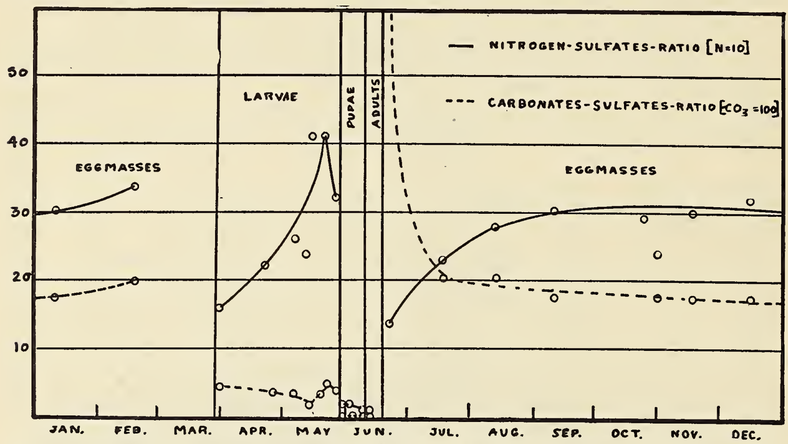

FIG. 3. Relation of nitrogen and sulfates and carbonates and sulfates in tent caterpillars at different stages of their life cycle.

during the second part of this period, the nitrogen decreased at a rate only slightly faster than the sulfates were formed, but during the first part of this stage, when active tissue building took place, sulfates increased far more rapidly than nitrogenous substances disappeared, indicating that the nitrogenous substances were not used for the metabolic processes, but for reconstruction, while in the second part of the stage, when the larvæ were formed, the decrease in nitrogen runs parallel with the increase of sulfates, or in other words, the nitrogenous substances were used for the maintenance of life. It is of interest to note that during the pupal stage sulfates did not increase in relation to the nitrogen content, indicating that if nitrogenous matter was used it was not oxidized but utilized in the transformation processes as building stones without waste.

The relation between carbonates and sulfates (figure 3) changed very rapidly shortly after the eggs were deposited and while the larvæ were formed. During the feeding stage the relation between carbonates and sulfates, both assumed to be waste products but from different sources, remained nearly constant. During the pupal stage the ratios were practically alike for all determinations. The next question is, which of the two groups of substances, carbonaceous or nitrogenous, were utilized at a faster rate? Figure 4 showing graphically the ratios between

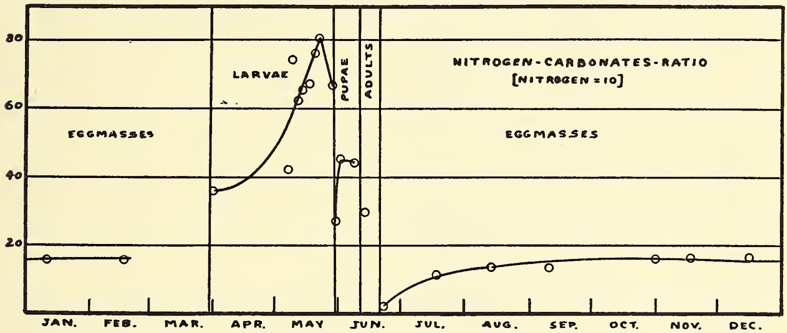

FIG. 4. Changes in the nitrogen-carbonates ratios of tent caterpillars.

carbonates and nitrogen is meant to indicate the answer. If the rate of accumulation of nitrogen had been the same as the rate of carbonates formation, a straight line could have been drawn between the calculated points. If, however, the curve of carbonates rises (when nitrogen is kept constant) the rate of their production must be greater or the rate of decomposition of carbonaceous material is greater than that of nitrogenous matter. It can be expected that results plotted for insects feeding on leaves will show an upward curve for carbonates in relation to nitrogen. During the formation of the larvæ and in the pupal stage this might be less evident if we left out of consideration fatty substances and glycogen. It seems clear however, that during three critical stages of development nitrogenous substances are of special importance, namely (1) when new larvæ are formed, (2) when the insect gets ready for pupation and (3) again when the pupæ are changing to the adult stage.

The relation between moisture content and sulfate formation

is graphically shown in figure 5. It is evident that during the first part of the life cycle of the insect (while the larvæ were confined in the egg cases) sulfate formation had a direct relation to the moisture content of the egg masses. When the larvæ were being formed sulfates increased rapidly and the moisture content went down, but the rate of sulfate increase was greater than the rate of moisture decrease. After the larvæ were formed the relation between moisture content and sulfates remained fairly

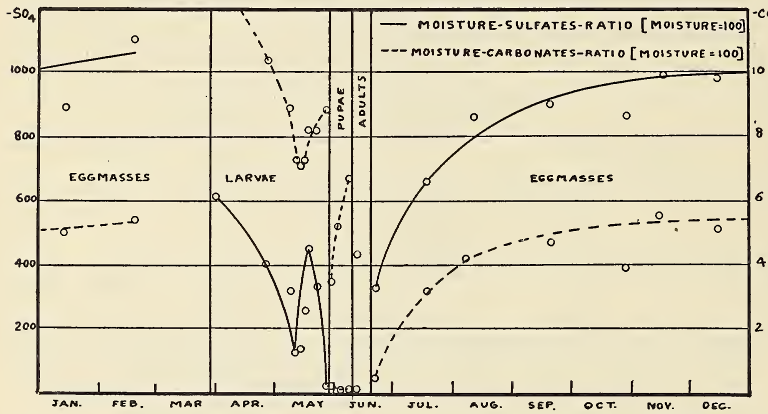

FIG. 5. Relation between moisture and sulfates and carbonates during the life cycle of tent caterpillars.

constant. As soon as the larvæ started feeding the moisture content increased more rapidly than the sulfate content but by the time the larvæ were one-third full grown this relation was reversed. Sulfates increased more rapidly than the moisture content until maturity was reached. As soon as the larvæ were full grown the relation between moisture content and sulfates remained practically constant until the prepupal stage, but changed again from the prepupal to the pupal stage. It remained thereafter constant until the adults emerged.

The relation between carbonates and moisture at the time when the larvæ were formed and remained in the egg cases is quite similar to the relation between moisture and sulfates during this period. When the larvæ hatched the carbonates were very high in relation to their moisture content, but this decreased rapidly until the insects were one-third full grown, similar to the rela-

tion between moisture and sulfates. This similarity indicates clearly to my mind that practically all the food intake was utilized for the building of new cells and preservation of life and not for storage, especially in view of the fact that fats did not start to accumulate appreciably until the low carbonate level was reached. The most interesting fact recorded during this part of the life cycle is that, when the larvæ were about full grown the sulfate content dropped in relation to the moisture content, whereas the carbonate content kept on increasing, or in other words, the carbonaceous material was utilized at this stage and not the nitrogenous matter. The next interesting thing occurred during pupation. In spite of the fact that fats actually increased

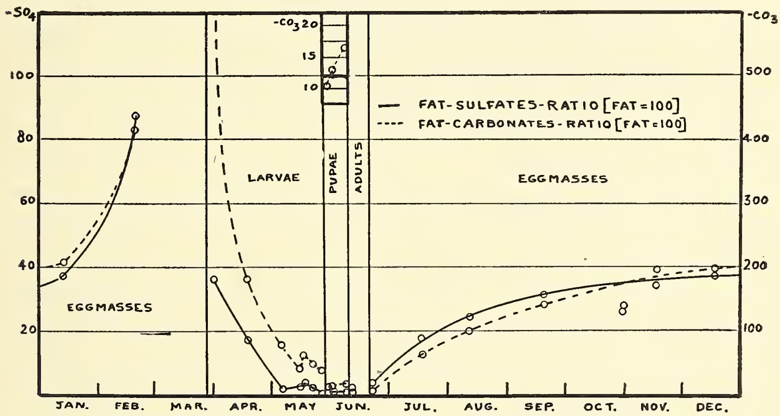

FIG. 6. Relation between fat content, sulfates and carbonates. Insert shows fat-carbonates ratios enlarged scale in pupal stage.

during this period and the sulfate content remained constant, the carbonate content increased from 3.48 per cent. to 6.72 per cent. (when the moisture content was kept constant) or an increase of 51.8 per cent. This increase again is explained by the decrease in glycogen content during this stage.

The relation between sulfates and carbonates and fats during the different stages is plotted in figure 6. At the time the larvæ were formed in the egg cases the relation between fats and sulfates changed rapidly; the sulfates accumulated at a faster rate than the fatty substances disappeared in spite of the fact that

fats decreased from 4.45 to 1.71 per cent. during the first twenty-six days. From the middle of August to the middle of January the relation between fats and sulfates remained fairly constant, but during the last months before hatching of the caterpillars sulfates increased very rapidly again, indicating that during this time, when the percentage fatty substances was low, nitrogenous materials were utilized for maintenance of the life processes. During the whole period when the caterpillars were feeding actively the rate of sulfate production was approximately the same as the rate of fat accumulation, while during the pupal stage the rate of fat increase was greater than the rate of sulfate accumulation.

If we assume for the time being that during the part of the life cycle when the eggs were deposited up to the time of hatching of the larvæ, most of the carbonates were formed as a result of the destruction of fatty substances, we note that during the period when the larvæ were formed carbonates accumulated at a faster rate than sulfates. As soon as the larvæ were formed the rate of carbonate production decreased somewhat but they were being formed at a faster rate than the fats were destroyed. Obviously other substances yielding carbonates were utilized for the maintenance of life. This is especially true near the end of the confinement of the caterpillars. The relation between carbonates and fats during the transformation processes of pupation changed somewhat (inset in the figure). During the first part of the pupation processes the percentage fatty substances actually increased on a dry basis (1) and at the same time carbonates increased. Again the explanation is furnished by the changes in glycogen content at this time.

I expect to discuss glycogen accumulation and its fluctuations in a future paper, together with data available on the weight and length of the insects. All original data and a general discussion and summary of the studies will be published.

Summary

Data obtained by chemical analyses on the accumulation and fluctuation of sulfates and carbonates, which are considered a part of the end products of the life processes of the apple tent

caterpillar, are presented graphically and discussed. The relation between sulfates and carbonates during the different stages of development and the fluctuations occurring are compared with the moisture, fat and nitrogen content of the insect.

Nitrogen appears to play an important rôle at three critical stages, namely (1) when the larvæ are formed, (2) when the insect gets ready for pupation and (3) when the pupæ change to the adult stages. Fatty substances are used and stored for energy and do not appear to be of special importance at any critical stage for tissue building. It appears that the moisture content of the insects during the different stages of development is directly related to the rate of their activities.

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THE COMMUNISM OF THOMAS SAY

By HARRY B. WEISS AND G. M. ZIEGLER

In the various biographical accounts of Thomas Say, and particularly in those appearing in scientific journals, little is said of his communistic life at New Harmony. Ord, in his memoir of Say, speaks disapprovingly and ironically of the labors of Owen and Maclure in their Indiana settlement, "where the sum of human happiness, it was believed, would be exalted; and where science and letters, it was confidently affirmed, would soon arise, like the orient sun, to enlighten our benighted western world."[1] Ord's account, however, was written shortly after the failure of Owen's "social system" and without the perspective of time, for out of Owen's and Maclure's utopian endeavors certain successful social movements can be traced.

We are not here concerned with Say's scientific attainments, which are well known and fully recognized, but rather with the motives which may have induced him to go to New Harmony, and with his life while there.

New Harmony, located on the Wabash River, in Indiana, was settled in 1815 by George Rapp and his disciples. Previous to this time, or in 1803, Rapp and a few followers came to the United States from Germany in search of religious freedom, and purchased a piece of land near Zehenople, Pennsylvania. A year later, three boatloads of his followers came over, of which six hundred settled with Rapp, and the remainder, or about one-third, founded another settlement in Lycoming County under a Mr. Haller. In 1805 a "community of equality" was established, and Rapp's followers agreed to live and dress simply, to give their possessions to the community for the common good, and to work for the community at large. Later they renounced marriage and tobacco.

The industry and unity of the Rappites soon developed a remarkable prosperity. Two thousand acres of cultivated land

[1] George Ord, in "A Memoir of Thomas Say," 1834.

were producing exceptional yields, and woollen and other factories were established. Realizing, however, the limitations of their location, twelve miles distant from navigation, and also the inadaptability of their land for fruit culture, they sold their Pennsylvania property and purchased a large tract of land in Indiana, where they founded the village of ''Harmonie.'' Here, too, the thrifty Germans flourished under the able leadership of Father Rapp, and their membership increased. For reasons which do not seem quite clear at this time, they again sold out in 1824, this time to Mr. Robert Owen, and moved to a place eighteen miles below Pittsburgh, on the Ohio River, where they built a village and named it ''Economy.'' This is the ''Rapp's Economy'' where Professor B. Jaeger, as set forth in his ''North American Insects'' (1854, page 199), ''was happy to be able to purchase some fine silk handkerchiefs, which were manufactured there out of silk of their own raising.''

Leaving the Rappites at Economy, we come to the activities of Robert Owen, an English social reformer and cotton manufacturer who labored to relieve the terrible conditions of factory workers during the Industrial Revolution, by improved housing, the establishment of schools, sickness and old-age insurance, recreation centers, etc., thereby earning for himself the enmity of his business associates. He was opposed to child labor and worked hard to secure the passage of reform legislation. However, a public declaration of his religious beliefs did much to destroy his popularity and plans, and in 1819, when he stood for Parliament in Lanark borough, labor leaders, factory owners, and even the laboring people who had been the objects of his altruism for many years, combined to defeat him.

When Richard Flower, who had been commissioned by Father Rapp to sell the Harmonist holdings, visited England, he found Robert Owen in a favorable frame of mind toward its purchase. In December, 1824, Mr. Owen visited the United States, and in the spring of 1825 he became ''the owner of an estate consisting of nearly thirty thousand acres of land—three thousand under cultivation by the Harmonists, nineteen detached farms, six hundred acres of improved land occupied by tenants, some fine orchards, eighteen acres of bearing vines, and the village of Har-

monie, with its great church, its brick, frame and log houses, and its factories, with almost all the machinery.''[2] Everything was in readiness for the founding of his ideal community.

Mr. Owen hoped to reform society by establishing cooperation, brotherly love, and universal education, and through the absence of competition and of religious motives. All possessions were to be held in common by the people; everyone was to have equal advantages and freedom; middlemen were to be abolished and direct distribution from producer to consumer effected; the truth was to be taught and people were to be liberated from their superstitions; schools and asylums were to be built; women were to have equal rights with men; labor was to be made pleasant and attractive; gold and silver as media of exchange were to be replaced by a medium which would fluctuate correlatively with changes in the value of materials; the family was to be replaced by associations of from 500 to 2,000 people, and the associations united in tens, hundreds, etc.; community government was to be by a general council to which all members between the ages of thirty and forty belonged, and various departments were to be run by committees.

As for religion, Robert Owen said that a Supreme Power was the cause of all existence. In his own words, ''The practice of the rational religion will consist in promoting, to the utmost of our power, the happiness and well being of every man, woman and child, without regard to their sect, class, party or color, and its worship, in those inexpressible feelings of wonder, admiration and delight, which, when man is surrounded by superior circumstances only, will naturally arise from the contemplation of the infinity of space, of the eternity of duration, of the order of the universe, and of that Incomprehensible Power, by which the atom is moved, and the aggregate of nature is governed.''

During February and March, 1825, Robert Owen explained his ideas and plans to large and distinguished audiences in the Hall of Representatives at Washington, and a little later public announcement was made of the opening of the colony and invitations to membership were extended to all who were in sympathy with the undertaking. This proclamation was so successful that

[2] George B. Lockwood. The New Harmony Communities, 1902, p. 75.

"New Harmony became the rendezvous of enlightened and progressive people from all over the United States and northern Europe. On the other hand, there came to New Harmony scores of cranks with curious hobbies, many persons impelled by curiosity and many others attracted by the prospect of life without labor. The heterogeneous mass would have afforded Charles Dickens an unlimited supply of character studies, for eccentricity ran riot in a hundred directions. The large majority were free-thinkers, attracted by Robert Owen's unorthodox religious views."[3]

On May 1, 1825, the "Preliminary Society of New Harmony," was formed and a constitution adopted. The purpose of this preliminary organization was to "improve the character and conditions of its own members and to prepare them to become associates in independent communities, having common property." Owen realized the necessity of educating and training the new members before his ideal community could be attained, and so he enlisted the support of William Maclure, wealthy Philadelphia geologist and principal founder of the Philadelphia Academy of Natural Sciences, who had excellent ideas on education but hazy ones on political economy. Maclure, who invested $150,000 in the scheme but limited his liability to $10,000, believed that he could make New Harmony the center of education in America. Between them, they collected and brought to New Harmony on January 18, 1826, such celebrities as Thomas Say, Charles Alexander Lesueur, artist and naturalist; Constantine Samuel Rafinesque, teacher of natural history, botanist and author; Dr. Gerard Troost, a Holland geologist; John Chappelsmith, artist and engraver; Professor Joseph Neef, a Pestalozzian educator; Robert Owen's four sons, trained for teaching and chemistry, besides others of lesser fame.

It would be interesting to follow the history of the undertaking in some detail, but as this is supposed to be an article about Thomas Say it will suffice to state that dissension arose, new communities were formed by original members who were not in sympathy with Owen's liberal religious views, the workers tired of supporting the idlers, jealousies flourished, Owen's philosophy

[3] Lockwood, *l.c.*, p. 103.

was criticized, lazy members were ousted, Maclure and Owen quarreled over property, the law was invoked to settle their dispute, Owen returned to England, and Maclure went to Mexico. In a short time the disorganization was complete.

It is difficult to determine definitely the extent of Thomas Say's interest in Owen's scheme for the betterment of humanity. Before going to New Harmony Say had been associated with Maclure during the early days of the Philadelphia Academy of Natural Sciences, and in 1818 he, Peale, Ord and Maclure visited the coasts of Georgia and eastern Florida for the purpose of studying natural history. Although his early years, and later ones too for that matter, were not crowned with financial success, and although his failure in the drug business, followed as it was by the necessity of living in the rooms of the society and doing his own housework and cooking, resulted in a condition bordering on poverty, yet these experiences, while perhaps tending to make Say sympathetic with unfortunate humanity, were totally unlike those of Owen, who was familiar with the squalor, wretchedness and extreme poverty of factory workers in English towns.

However, Say was always at the service of others and of such an amiable and trusting nature that he may have readily absorbed the impassioned accounts of Owen and Maclure of the good life to be led at New Harmony. His biographers have described his personality in such terms as "bland," "conciliatory," "modest," "diffident," "retiring," etc., leading one to assume that he perhaps did not hold definite or intense opinions upon many subjects. Although he may have been reticent in expressing his views, the fact that he had them and could become indignant upon occasion is indicated by his statement in a letter to John F. Melsheimer in 1818 about his Florida trip, wherein he speaks of the "most cruel & inhuman war that our government is unrighteously & unconstitutionally waging against these poor wretches whom we call savages."[4]

Again, he may have been more interested in Maclure's educational program for New Harmony and the opportunities for research work which were to be afforded, than in Owen's economics. Maclure was his friend and patron, and Say's strong sense of

[4] Ent. News, Vol. XII, p. 235, 1901.

duty may have outweighed any doubts as to the outcome of the venture. During the six or seven years previous to 1825, when he went to New Harmony, his time was occupied with expeditions and teaching, neither of them very remunerative, and he was unmarried and in poor health. Perhaps New Harmony appeared to him as a utopia, an opportunity to escape from illness and teaching to a life of scientific work with agreeable associates, interrupted only by the necessity of supplying his modest wants. Perhaps his dependence upon Maclure's patronage was such as to exclude the possibility of refusing to go. Whatever his motives may have been, he made the trip and was part of the "Boat Load of Knowledge" that descended upon New Harmony in the middle of January, 1826. It is apparent, even from the meager accounts accessible to us, that once there Say entered fully into the spirit of Owen's and Maclure's plans.

The Duke of Saxe-Weimar, who visited New Harmony in 1826, recorded his impression of Say as follows: "I renewed acquaintance here with Mr. Say, a distinguished naturalist from Philadelphia, to whom I had been introduced there, but unfortunately he had found himself embarrassed in his fortune, and was obliged to come here as a friend of Mr. Maclure. The gentleman appeared quite comical in the costume of the society, with his hands covered with hard lumps and blisters, occasioned by the unusual labor he was obliged to undertake in the garden."

It is conceivable also that Say took part in the social life of the community, at least that part of it involving his immediate friends. Miss Lucy Sistare, who became Mrs. Say, was one of the belles of the place and fond of dancing, and it is not unlikely that Say, in spite of his bashfulness, found it expedient to please her. As to the living, the Duke said, "Upon the whole, I cannot complain either of an overloaded stomach, or a headache from the wine. The living was frugal in the strictest sense." Ord infers that both Maclure and Say carried their abstinence from food too far, in view of the fact that each lived for a considerable time on six cents a day.

When the "permanent" community was formed, Mr. Say was elected by the parent community as superintendent of literature, science and education, a comprehensive title. If Ord's account

is true, Say was poorly fitted to superintend either literature or education. Say received his early training in the Friends' Academy of West-town, Pennsylvania, where he acquired a ''distaste for letters'' and classical literature. These he did not miss until later in life, and then his passion for making discoveries occupied his attention to the exclusion of everything else. Maclure, too, was not partial to belles-lettres. He considered literature as an ''ornamental'' branch of study as opposed to the ''useful'' sciences. He believed that ''a plain, simple narrative of facts, got by evidence of the senses,'' was ''all the literature that ninety-nine one-hundredths of mankind have occasion for.'' Such was the treatment of belles-lettres at the hands of a geologist and entomologist in New Harmony.

While at New Harmony, Say had an opportunity to introduce reforms into entomological nomenclature, but he failed to utilize it. One of his fellow superintendents, Stedman Whitwell, worried by the number of ''Washingtons'' and ''Springfields'' that were appearing in every state, proposed a system of nomenclature by which a locality could be given a distinctive name that would indicate at once the latitude and longitude of the place, thereby enabling one to locate it geographically. Whitwell's scheme involved the use of letters as shown below as substitutes for the figures expressing latitude and longitude.

	1	2	3	4	5	6	7	8	9	0
Latitude	a	e	i	o	u	y	ee	ei	ie	ou
Longitude	b	d	f	k	l	m	n	p	r	t

The latitude was to be indicated by the first part of the town name and the longitude by the second part, by substituting letters for the figures in the above table. ''S'' in the latitude name indicated that it was south latitude, and its absence denoted north latitude. ''V'' denoted west longitude, and its absence east longitude. By this method, New Harmony, 38°, 11′, N; 87°, 55′, W, became Ipba Veinul; New York, Otke Notive; Pittsburgh, Otfu Veitoup, and Washington, Feili Neivul. According to Lockwood,

"the principal argument in favor of the new system presented by the author was that the name of a neighboring Indian chief, 'Occoneocoglecococachecachecodungo,' was even worse than some of the effects produced by this 'rational system' of nomenclature." Elaborate rules for the pronunciation of the compound names were formulated by Whitwell.

After the failure of Owen's social system and Maclure's Educational Society, Maclure stayed at New Harmony and continued his experiments in education, running a seminary for both sexes. In 1828 he went to Mexico for his health, leaving his interests in Say's charge. With no other means of support, Say was compelled to remain at New Harmony, which he did until his death in 1834. However, New Harmony was a focus for scientists for many years after its failure as a "community" and here Say did much of his work on the "American Conchology" and his third volume of "American Entomology."

Although the New Harmony communities, wrecked as they were by the human factors of stupidity, greed, jealousy, cussedness and arrogance, were laid out by Owen along carefully planned economic lines, they did not after all constitute the kind of Utopia that most of us look forward to without any hope of attaining. They were too practical, too much like the real world, and too much like poor colonies. Say's communism, if it can be so called, was apparently incidental to the rest of his life, and of his own private Utopia we know nothing.

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OBSERVATIONS ON THE HABITS AND LIFE HISTORY OF THE MOTH—LOPHOPTILUS ELOISELLA

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The lavernid moth, *Lophoptilus eloisella,* has been known to be associated with the evening primrose since 1875, when Chambers gave it the specific name of "*oenotheraella.*"[1] Miss Murtfeldt, however, was the first one who really made any very detailed observations upon its life history. She described the larva and its general habits, the pupa and its period of pupation.

The yellow larvæ of this moth are found in great numbers inside the stem of the evening primrose at Ithaca, N. Y., where I collected them in the late winter of 1925–26. Practically every stem which was opened had at least one of these larvæ in the pith. One stem had thirteen in its extent. Usually one finds three to four.

They are found as a general rule in the pith cavity of the middle half of the stem, and only occasionally are they found in the thicker and much woodier lower fourth of the stem, or the upper part where the spikes of flowers arise.

One finds the larvae in the pith in September and October. At this time or a little later, each has already eaten practically all the pith in its neighborhood for a length of 0.8 cm. to 2.2 cm., but the usual distance so cleared is about 1 cm. The larva cleans this area thoroughly, and builds up at each end more or less of a cone-shaped pile of frass, stuck together with silk. The bases of the cones, facing one another, form the inside boundaries of the little chamber so constructed by the larvæ, and the apices of the cones are directed into the undisturbed pith. The disks or bases of the cones are lined by a very fine layer of silk, as are also the sides of the cylindric chamber, later on.

[1] Canad. Ent., Vol. VII. Pp. 30 and on. 1875.

During the months of March or April, depending upon the temperature, the larvæ become much more active. A second layer of silk, denser than the first, and inside of it, is spun about the chamber. A little hole is cut through the wall of the stem as far as the cuticle, at the upper end of the chamber. The silk lining of this chamber is extended into and also lines this hole and the chips are imbedded in the silk on its upper side.

Then the larva proceeds to weave about itself a cocoon of very closely matted silk (Fig. 2, B), in which the later formed pupa seems to be suspended. During pupation the head capsule of the larva is shifted and finally caught in the lower part of the cocoon. This third layer of silk is extended above through the exit hole before described, so that the imago may pass immediately to the exterior when the cuticle is ruptured.

Pupal Stage.—(Fig. 1, C; Fig. 2, B.) The pupæ kept in the laboratory emerged after about two weeks. Those in the field had a period of pupation of about forty days during the summer of 1926. The early part of the summer, however, was unusually cool, and probably ordinarily Miss Murtfeldt's estimate of about twenty to twenty-five days is a better average.

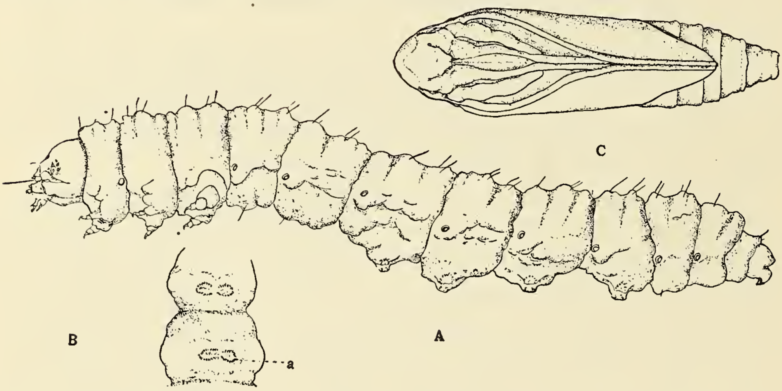

FIG. 1. A. Lateral aspect of caterpillar of *Lophoptilus eloisella*—just before pupation. B. Ventral aspect of the third and fourth abdominal segments of the caterpillar, (a) abdominal prolegs showing arrangement of chitinous hooks. C. Ventral aspect of pupa (specimen was preserved in alcohol, so is contracted somewhat).

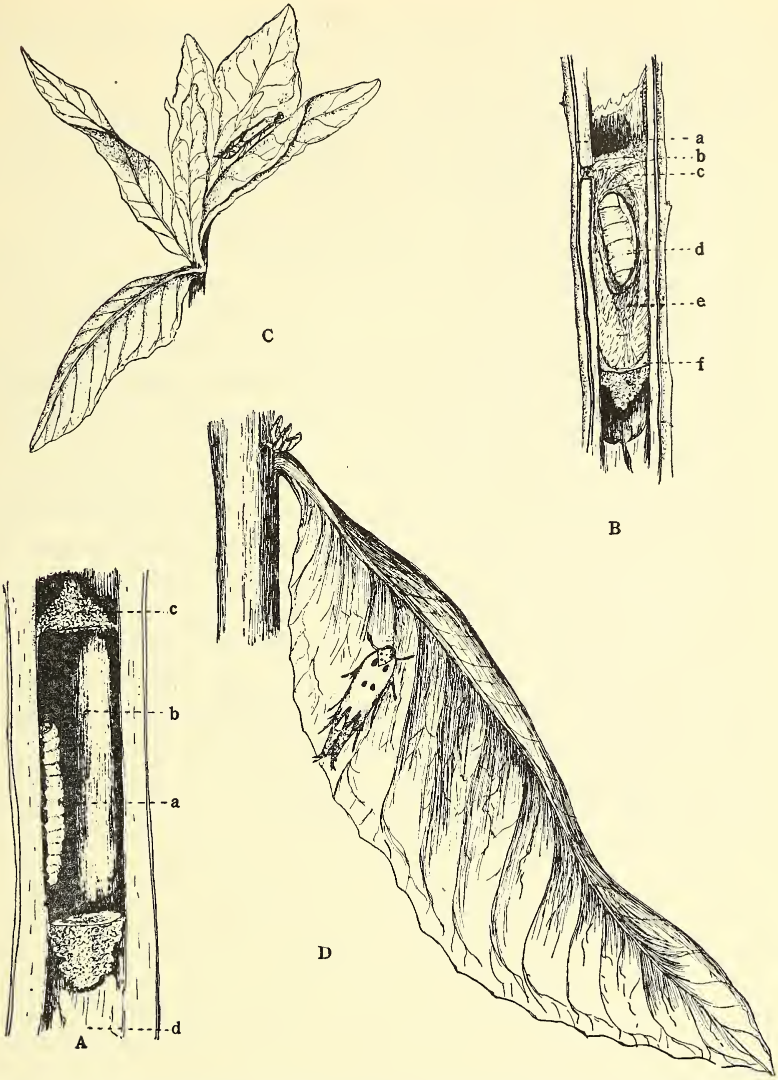

FIG. 2. A. Longitudinal section of a portion of a stem of the evening primrose, showing caterpillar (a), in its chamber (b), (c) frass pile, (d) solid pith. B. Another section showing pupa suspended in its cocoon; (a) cuticle of stem; (b) exit hole for imago; (c) middle layer of silk; (d) pupa (the three layers of silk cut away); (e) inner layer of cocoon; (f) outer layer of silk. C. Tip of stem of evening primrose, with lateral view of imago, recently emerged. D. Leaf of evening primrose, with imago of *Lophoptilus eloisella*, in characteristic resting position.

In 1926, at Ithaca, I found the larvæ, and later the pupæ were very heavily parasitized. Not more than one half of the larvæ brought in from the field emerged as imagoes.

The first of these parasites to appear is the ichneumonid *Epiurus pterophori*[1] Ashmead. Then followed: *Epiurus pterophori* Ashm.,[2] *Eurytoma tylodermatis* Ashm.,[2] *Chelonus fissus* Prov.,[2] *Bassus gibbosus* Say[3] and an undescribed species of *Orgilus*.[3].

In addition, there is the mite *Tyroglyphus lintneri* which was found to be feeding upon the larva as it was constructing its silk layers.

By the middle of August (of the year 1926) the young larvæ were found boring in the stems. Quite a range in size was noticeable at this particular time, and of course the length and size of the burrow varied accordingly.

It was possible to locate the point of entrance of the larva by following the burrow as it diminished in size. In all cases it was found that the larva followed the vascular system of a leaf into the stem. In several cases the writer traced the tiny burrow to the exterior—along the midrib of a leaf on its upper surface.

Not only were the lepidopterous larvæ found in the stems at this time, but also the larvæ of at least two parasites were inhabiting the pith. In several cases, the moth larva had been killed already by the parasite which had invaded its burrow.

2 Kindly determined for me by R. A. Cushman.

3 Kindly determined for me by A. B. Gahan.

ON THE CEPHENEMYIA MECHANISM AND THE DAYLIGHT-DAY CIRCUIT OF THE EARTH BY FLIGHT

By Charles H. T. Townsend

In the April, 1926, issue of the *Scientific Monthly,* the writer published an article on this subject, which was commented on by Mr. H. V. Haight in the succeeding issue of the same journal. Mr. Haight's points are very well taken, and his remarks on fuel are of especial interest and importance.

Mr. Howard S. Rappleye, of the U. S. Coast and Geodetic Survey, called the writer's attention by letter to the fact that the length of the 40th parallel is 19,103 statute miles and that of the 60th parallel 12,483 statute miles; also that, as observed by Mr. Haight in his comments, 815 miles per hour exceeds the speed of dawn, whereby a westward flight at that speed, starting from New York at dawn, would keep the flyer in darkness for the entire circuit, on the basis of the erroneous length of the parallel.

The writer was keeping strictly in mind the ordinary single daylight-day of 17 hours at a given point on the 40th parallel, like New York, in June; and the daylight-day of 18 hours on the 60th parallel, likewise at a given point. He confesses to having overlooked the fact that 815 miles per hour exceeds the speed of dawn. However, while this would in great part eliminate the sight-seeing element of the trip, flying westward on the original schedule, the result would remain the same and one would get back to New York the same date on which he left there. At the same speed of 815 miles per hour, one could travel east on the 40th parallel and experience two short daylight-days divided by a short night, all on the same date at New York. But by the revised length of the 40th parallel we see that the circuit either way at this speed would consume nearly 23½ hours. On the 50th parallel it would consume little over 19½ hours, and on the 60th parallel little less than 15 1–3 hours.

A speed of only 466 miles per hour is necessary to circle the earth westward on the 40th parallel of north latitude in June from dawn to dusk of the aviator's day, since the flyer would have 41 hours of continuous daylight on such trip, and only about 385 miles per hour will accomplish this circuit on the 50th parallel; while about 297 miles per hour will do the same on the 60th parallel, where the flyer would have at least 42 hours of continuous daylight. This is not a single daylight-day from the viewpoint of a fixed locality, but a double daylight-day; yet, from the viewpoint of the flyer, constantly moving westward, it amounts to a single daylight-day in effect. It is of extreme interest as affording a mark that should be reached within the next decade; while the more remote future holds the possibility of riding the tail of high noon or speeding on the wings of the morning halfway between the equator and either pole. It can not be denied that the double daylight-day westward circuit will attain great popularity before the single daylight-day circuit is realized.

The new trend of experimental invention is toward the development of the ornithopter type of air machine. This is the flapping-wing type. Many facts point to the possibility that this type, or an acceleration of it, will eventually materialize and outdo the airplane in general utility and effectiveness. In view of this, the structure of the Cephenemyia wing takes on an increased importance. The flapping wing of the bird has a very different structure from the vibrating wing of the fly, and extended experiment may easily result in demonstrating the superiority of the latter for purposes of mechanical flight. The fly-wing type of air machine may be termed Myiopter.

The main object of this article is to call attention to the peculiar structure of the fly wing. The Cephenemyia wing has never been critically studied, but the *Musca vomitoria* or blowfly wing has been quite exhaustively described by Lowne and Ritter. The main features of the two should be much the same, but it is quite certain that the Cephenemyia wing is far more perfected in detail. The chief mechanical interest in the matter hinges on the unique method of articulation of the fly wing with the body. This, unlike the articulation of the bird wing, is accomplished by

seven peculiarly shaped sclerites assembled on a particular plan and massed together in the wing base. These sclerites, through their form and system of coordination, function in allowing the greatest freedom of movement combined with the utmost rapidity of stroke.

Below are the names of these seven sclerites, with a brief description of the characters and functions of each:

1. *Epaulet.*—A subcircular scalelike sclerite fringed with bristles and set at the extreme base of the wing. It springs from the margin of the pre-epaulet, which is a hoodlike pouch of the epipleural body-plate, and articulates with the dens and the coracoid. It protects the wing joint in front.

2. *Subepaulet.*—A bare subscalelike sclerite lying beneath and distally to the epaulet. It springs also from the margin of the pre-epaulet, gives off a process to connect with the coracoid, and articulates with the costa or outer marginal rib of the wing. It gives free movement to the costa.

3. *Dens.*—A sclerite consisting of a compact body with four protuberances or processes, of which only the main one or dentate process is externally visible. It articulates anteriorly with the epaulet, and posteriorly with the unguiculus. It increases the freedom of movement of the costal border of the wing.

4. *Coracoid.*—A sclerite wedged in between the epaulet and the unguiculus. It tends to prevent the dislocation of the remigium, which see further on.

5. *Unguiculus.*—A peculiarly shaped sclerite consisting of a horizontal and a vertical plate and a stirruplike structure. Its horizontal plate is wedged between the coracoid and the dentate process of the dens. Its vertical plate lies between the dentate process of the dens and the rest of the propterygium (epaulet and subepaulet). The stirruplike portion projects below the wing base in the form of a hook which articulates with the epipleural body-plate. It provides extreme freedom of wing movement.

6. *Hypopterygium.*—A curved capitate sclerite surrounded by an erectile papilla and capped by an elastic hood of hyaline tissue. It articulates proximally with the posterior edge of the pre-epaulet. It functions during extension of the wing by inter-

position between the articulation of the preceding sclerites with the remigium.

The six sclerites above described constitute the anterior root of the wing. The epaulet, subepaulet and dens comprise the propterygium or front subsystem; the coracoid and unguiculus comprise the mesopterygium or mid-subsystem, and the hypopterygium alone forms the hind subsystem of the anterior root.

The epaulet and subepaulet, taken together, form a series which springs from the pre-epaulet and articulates distally with the costa or front rib of the wing. The dens, coracoid, unguiculus and hypopterygium form a series which articulates proximally as a whole with the body projection known as the head of the anterior alar apophysis of the postscutum, and distally with the remigium or common root of the subcostal and radial trunks of the wing ribbing.

7. *Metapterygium.*—This sclerite forms the entire system of the posterior root of the wing. It consists of two limbs united at an obtuse angle, the anterior limb being called the deltoid and the posterior limb the humerus. It articulates proximally with the terminal socket of the posterior alar apophysis or inferior process of the rim of the scutellum, and distally with the patagium or common root of the medial, cubital and axillary trunks of the wing ribbing. It gives free movement to the inner border of the wing.

To supplement this brief survey of the fly wing articulation, it is necessary to make some mention of the muscles which control the wing. These are classed in two series, the great thoracic and the alar articulation muscles.

The great thoracic muscles are enormously developed and nearly fill the whole thoracic cavity of the fly. They furnish the real wing power and consist of nine pairs of very large muscle-bands. They comprise six pairs of nearly longitudinal *dorsals* in the central portion of the thorax, and three pairs of nearly vertical *sternodorsals* outside these in the lateral portions of the thorax. The contraction of the dorsals acts by increasing the convexity of the roof of the thorax, raising certain of the exoskeletal wing articulation processes, which in turn lower certain other like processes that act as levers to depress the wings. The

contraction of the sternodorsals raises the wings by vertical compression of the thorax, acting conversely to the dorsals on the respective processes.

The alar articulation muscles form an elaborate series of ten pairs controlling the wing roots. Their names and functions are given below. Complete origins, attachments, courses and insertions can not be given, since these would entail descriptions of the many thoracic-wall sclerites and processes, which are beyond the limits of the present article. But enough is given to furnish an index to the wing root articulation musculature.

1. *Adductors.*—These are complex, being partly muscle, partly tendon traversing the postalar foramen, and partly postalar ligament, the last stretched between and inserted in four different processes of the wing base and body-wall. They function in drawing the wings back toward the body, serving to restore them from the position of flight to that of rest.

2. *First abductors.*—Delta-shaped muscles broadening distally and inserted in the cruriform process of the parapteron, which is mainly an internal sclerite of the thoracic wall. They function in drawing the wings horizontally forward.

3. *Second abductors.*—These are the strongest of all the alar articulation muscles and are also delta-shaped. Each lies beneath the first abductor of its side, is continued in a tendon under the parapteron, traverses the postalar foramen and is inserted on the front border of the wing joint. They function with the preceding in drawing the wings horizontally forward, one pair effecting this while the wings are depressed, thus causing the forward movement both during and after the down stroke of the wing.

4. *First levators.*—Delta-shaped muscles which pass into a long delicate tendon that is inserted into one of the processes of the wing base. Their contraction depresses the process, causing the wings to rise and at the same time drawing them somewhat backward.

5. *Second levators.*—Rhombic muscles passing into a strong tendon which is inserted into the same process in the wing base with the preceding. They function with the first levators in raising the wings and drawing them somewhat backward, their contraction depressing the process.

6. *First supinators.*—Delta-shaped muscles passing into a tendon which is inserted into the anal ligament. They function in depressing the anal portion of the wings.

7. *Second supinators.*—Also delta-shaped, each arising at an apodeme behind the first supinator of its side, being then continued in a long tendon which passes through the postalar foramen and is inserted in the anal ligament. They function with the first supinators in depressing the anal portion of the wings.

8. *Pronators.*—Slender delta-shaped muscles, each passing with the second abductor tendon of its side under the parapteron, being then continued in a tendon which traverses the prealar foramen and is inserted on the wing joint. They function in depressing the anterior border of the wing, apparently increasing the wing torsion during the down stroke. These and the two pairs of supinators appear to produce the torsion of the wing surface and change its degree as required.

9. *Graciles.*—Small oval muscles arising from the parapteron and continued in a delicate tendon which is inserted in a process of the body wall. Their function is obscure.

10. *Anonymi.*—Very delicate and covering the episternum. Function unknown.

Fuller details of the above sclerites and muscles in *Musca vomitoria* may be found in B. T. Lowne's "Anatomy and Physiology of the Blowfly," 2 vols., London (1892–95); and in W. Ritter's "Flying Apparatus of the Blowfly," Smithsonian Miscellaneous Collections, vol. LVI, Washington (1911). The Cephenemyia wing, however, will certainly be found to differ in important details, and must be thoroughly studied on its own. The *Musca vomitoria* mechanism merely paves the way to a realization of the complexity of the Cephenemyia mechanism.

Regarding the speeds of Cephenemyia, the idea of a fly overtaking a bullet is a painful mental pill to swallow, as a friend has quaintly written me, yet these flies can probably do that to an old-fashioned musket ball. They could probably have kept up with the shells that the German big-bertha shot into Paris during the world war. The males are faster than the females, since they must overtake the latter for coition. Then the males

habitually fly at higher altitudes than the gravid females, and thus encounter less friction which enables them to attain greater speeds. Besides the gravid females are heavily laden with ova and young, which must make them slower than the males. At 7,000-foot levels in the Sierra Madre valleys of western Chihuahua I have seen the gravid females pass while on the search for hosts at a velocity of well over 300 yards per second—allowing a slight perception of color and form, but only a blurred glimpse. On the other hand, on 12,000-foot summits in New Mexico I have seen pass me at an incredible velocity what were quite certainly the males of Cephenemyia. I could barely distinguish that something had passed—only a brownish blur in the air of about the right size for these flies and without sense of form. As closely as I can estimate, their speed must have approximated 400 yards per second.

Both the bird and the fly exemplify in a general way the flapping wing movement, but the fly wing is far speedier in its up-and-down movements and must be termed the vibrating wing. The bird has an internal skeleton, hence its wing articulation is internal to the muscular system. The fly has an external skeleton, thus its wing articulation is external, the muscles being protected inside the skeletal structures. The latter type alone admits of the peculiar complex wing base of the fly. These constitute the radical differences between the ornithopter and myiopter types of mechanism. The external articulation appears to be the more efficient. Air machines will, therefore, probably attain greater efficiency if modeled on the myiopter plan.

New construction materials of great strength and resiliency, new fuels of superior concentration, and new and superefficient motors are all three coming to the front at the present moment. With these aids, the myiopter type of machine should far excel anything heretofore accomplished in the air, and may well aim at exceeding the speed of the dawn.

The idea of beating the speed of the earth's axial revolution holds fascinating possibilities. Short stops could be made at various points when necessary to replenish power and supplies as well as for frequent change of machines at regular bases, and one could still keep abreast on the average with the westward ad-

vance of midday. As the daylight-day shortens in the northern hemisphere, one could follow the sun across the equator into the southern hemisphere with its long December days of daylight, thereby keeping the glowing orb always in the zenith. We can go Joshua one better by causing the sun to recede eastward from the aviator's viewpoint, provided only that we can attain the alleged speed of Cephenemyia.

GALLS ON STEMS OF CULTIVATED BLUEBERRY (VACCINIUM CORYMBOSUM) CAUSED BY A CHALCIDOID, HEMADAS NUBILIPENNIS ASHM.[1]

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The reniform, pithy, polythalamus galls commonly found on the stems and branches of several species of *Vaccinium* have been quite abundant for the past several years on cultivated blueberries in New Jersey. The Sam variety of *V. corymbosum* seems to be particularly susceptible to the formation of this gall. In one field planted to this variety, nearly all of the plants were found to have galls in 1925 and 1926. During the season of 1926, another variety (Harding), planted alongside the Sam variety, was found infested but to a less extent than the latter.

Specimens of the galls sent to the office of the State Entomologist of New York were determined as those of the cynipid, *Solenozopheria vaccinii* Ashm. Specimens of the galls, and five different species of chalcidoids that were reared from them, were sent to the National Museum at Washington, D. C. The galls were determined either as parasites on the gall maker or as "guest flies." Dr. A. B. Gahan, of the National Museum, expressed some doubt whether the galls were caused by the cynipid to which they are commonly ascribed. He thought it probable that the galls were caused by *Hemadas nubilipennis* Ashm., a species commonly reared from the galls.

Lack of knowledge concerning the life history and habits of the gall maker has been a handicap in devising suitable control measures. The experiments reported at this time were carried on in an effort to isolate the true gall maker and to gain some knowledge of its life history.

[1] Paper No. 353, of the Journal Series, New Jersey Agricultural Experiment Station's Department of Entomology.

History of the Gall

In 1887, Dr. W. H. Ashmead published a description of the gall in *Transactions of the American Entomological Society,* volume 14. He described the gall as a "reniform, pithy gall on the stem or branches of *Vaccinium corymbosum* and *V. pennsylvanicum.*" Dr. Ashmead bred one female cynipid from the galls in February, 1886. He set up a new genus and species, naming the insect *Solenozopheria vaccinii.* The formation of the gall was ascribed to this species.

The writer has tried to rear the cynipid in question from hundreds of galls but with no success. Inquiry revealed the fact that others had made numerous attempts to rear the supposed gall maker but had failed.

Besides the single cynipid specimen, Dr. Ashmead named and described three chalcidoids that were reared from the Vaccinium galls. The three species which are commonly reared from the galls are: *Hemadas nubilipennis* Ashm., *Ormyrus vacciniicola* Ashm. and *Eurytoma zolenozopheriae* Ashm. Dr. Ashmead thought these chalcidoids were either parasites or guest flies.

Rearing Experiments

In the winter of 1925–1926 and the spring of 1926, the writer collected 400 galls from a cultivated variety of *Vaccinium corymbosum.* Collections were made up to the first week in May, 1926. All the galls were placed in one large cage and the insects allowed to emerge throughout the spring and summer of 1926. Most of the galls, and especially those collected the first week in May, had quite a number of exit holes when collected, indicating that some of the insect inhabitants had already emerged. Previous observations had shown that a few individuals of the two species, *Eurytoma solenzopheria* Ashm., and *Ormyrus vacciniicola* Ashm., emerge in the fall of the same year in which the galls are formed. The number of individuals of each species that had emerged were recorded from time to time through the summer. The data are set forth in table 1. It was observed that the peak of emergence for *Hemadas nubilipennis* Ashm. occurred about the time the blueberry plants were putting out new vegetative

growth. The peak of emergence for *Decatoma* sp. came about two weeks after the peak of emergence for *Hemadas.* The other three species were never very numerous and were found to emerge over a longer period of time.

TABLE 1

SPECIES OF CHALCIDOIDS EMERGING IN 1926 FROM 400 GALLS FORMED IN THE SUMMER OF 1925

Species	No. of individuals found to have emerged at different dates				
	June 7	July 15	Aug. 1	Aug. 18	Sept. 21
Hemadas nubilipennis Ashm.	1,639	11	0	0	0
Decatoma sp.	891	5	0	0	0
Eurytoma solenozopheria Ashm.	184	33	0	0	0
Ormyrus vacciniicola Ashm.	70	27	0	452	84
Eupelmus sp.	16	13	0	0	0
Solenozopheria vaccinii Ashm.	0	0	0	0	0

An examination of the data in table 1 shows that not a single cynipid was bred out. The data also show that *Hemadas nubilipennis* Ashm. was the most numerous species to emerge. Dr. A. B. Gahan, of the National Museum, informed the writer that he had gotten similar results from rearing experiments. Another interesting point brought out by a study of the data in table 1 is the fact that a second brood of *Ormyrus vacciniicola* Ashm. emerged the first part of August. The individuals of this brood were much smaller than the individuals of the first brood. It is not known whether the eggs of this second brood were deposited in the old galls after the other species had emerged. If such was the case it would indicate that *Ormyrus* is a "guest fly" and not a parasite. No particular observations were made to determine if *Ormyrus* oviposits in the old galls. However, on May 10, the writer observed an *Ormyrus* individual trying to insert her ovipositor in an old gall. The individual was gently moved to a young growing twig but returned to the old gall. This was repeated several times. Another *Ormyrus* individual was found with her ovipositor held fast in an old gall.

Observations Made to Determine Which Species Oviposit in Blueberry Stems

The writer introduced fresh young stems of the blueberry in a breeding cage containing the five different chalcidoids. *Hemadas nubilipennis* Ashm. individuals immediately began ovipositing in the tender stems. Stems, with ovipositing individuals attached, were placed under binoculars and the ovipositing process observed. In ovipositing, the *Hemadas* individuals would place the anterior end of their body toward the growing end of the shoot. The full length of the ovipositor was inserted in the stem. After each insertion and removal of the ovipositor, the individual would move up the stem a very short distance and insert the ovipositor again. This action was repeated again and again until a row of punctures about an inch long was made in the stem. Several of the stems oviposited in by *Hemadas* were dissected. The bark on the opposite side of the stem from where the punctures were made was peeled off exposing the ends of numerous long white eggs placed crosswise the stem. Numerous twigs with the characteristic *Hemadas* punctures were collected in the field and dissected. Eggs were found in these stems similar to the eggs found in the stems exposed to *Hemadas* under controlled conditions.

Numerous observations were made to see if any of the other species would oviposit in fresh blueberry stems. None of them did. At a later time *Decatoma* sp. individuals were observed ovipositing in stems in which *Hemadas* had deposited eggs. Fresh stems beside the injured stems were ignored by the *Decatoma* individuals.

Experiments to Determine Which Species of Chalcidoids Cause Galls on Cultivated Blueberries

Fifty nursery plants of the Sam variety were potted on May 18, 1926. Young shoots on the plants were from one to four inches in length. The fifty plants were divided into five sets of ten plants each and the sets plunged in sand. Suitable cages were constructed over each of the five sets and the sets treated as follows: Set one was left as a check; into set two were intro-

duced fifty *Hemadas nubilipennis* Ashm. individuals; set three was given fifty *Hemadas* individuals, the object being to introduce individuals of the other species after the *Hemadas* individuals had deposited eggs; into set four were introduced 30–35 individuals made up of a mixture of *Eurytoma solenozopheriæ* Ashm. and *Ormyrus vacciniicola* Ashm.; into set five were introduced 50–60 individuals of *Decatoma* sp. The insects were introduced into the five cages on the morning of May 19, 1926.

The *Hemadas* individuals in sets two and three were noted ovipositing in the new growth shortly after they were introduced. The plants in the five sets were observed on May 25. Those in sets one, four and five were growing normally. The stems on the plants in sets two and three were badly injured by the ovipositing of the *Hemadas* individuals. On May 29, forty *Decatoma,* eight *Eurytoma* and seven *Ormyrus* individuals were introduced into set number three. On June 1, all of the plants in the five sets were removed to a large cage where they were kept for the remainder of the season.

The plants were observed from time to time throughout the growing season. Typical kidney-shaped galls formed on every one of the twenty plants exposed to *Hemadas nubilipennis* Ashm. No abnormal growths appeared on any of the plants in sets one and four. Two globular galls about a fourth of an inch in diameter were formed on one plant in set number five. It will be recalled that this set was exposed to *Decatoma* sp.

All the galls on the plants in sets two, three and five were removed on November 8, 1926, and placed in individual jelly glasses for the purpose of rearing the insects in them. All the plants in the five sets were examined carefully for galls at that time. Twenty-two galls were found on the ten plants in set number two and twenty-two galls on the ten plants in set number three. Two small galls were found on one of the plants in set number five. The plants in set one (check set) and set four (exposed to *Ormyrus* and *Eurytoma*) were free of galls.

Discussion of the Results Obtained from Experiments Carried on to Determine Which Species of Chalcidoids Cause Galls on Cultivated Blueberries

The galls formed on the plants in sets one and two (exposed to *Hemadas nubilipennis* Ashm.) show conclusively that this chalcidoid is capable of forming galls on blueberry plants. There was a possibility of the plants being exposed to other insects before they were caged and that some other insect was responsible for the galls. This is not probable, however, because the ten plants in set one were carefully screened to keep out insects and no galls developed on any of these ten plants.

The ten plants in set four, exposed to females of *Ormyrus vacciniicola* Ashm. and *Eurytoma solenozopheriæ* Ashm., showed no signs of gall formations. This indicates that neither of these two species is capable of forming galls alone. The inference to be drawn, then, is that these two species are present in the galls either as parasites or as "guest flies."

The two small galls found on one of the plants in set five (exposed to *Decatoma* sp?) seem to indicate that this species is also capable of forming galls on the cultivated blueberry. If *Decatoma* sp. individuals are capable of forming galls, it is surprising that fifty or sixty individuals did not produce more galls on the ten plants than what was found. There is the possibility that the two small galls found on one of the plants in set five were caused by the attack of another insect before the plants were caged. An effort is being made to rear insects from all of the galls formed under the controlled experiments. If *Decatoma* sp. is the only species bred from the two small galls in set five, it will indicate that this species is capable of producing galls on the blueberry.

Summary

Galls on the stems and branches of cultivated varieties of *Vaccinium corymbosum* have become so numerous that control measures are necessary. A study of the records showed that the galls are supposed to be caused by a cynipid, *Solenozopheria vaccinii* Ashm. Rearing experiments carried on for the pur-

pose of isolating the gall maker and learning something about its life history produced only chalcidoids, of which there were five different species. Laboratory observations disclosed the fact that one of the five species, *Hermadas nubilipennis* Ashm., deposits eggs freely in the young, growing stems of cultivated blueberries. In controlled cage experiments, in which separate sets of blueberry plants were exposed to the different species of chalcidoids, it was found that *Hermadas nubilipennis* Ashm. is capable of forming the reniform, pithy galls commonly ascribed to *Solenozopheria vaccinii* Ashm.

DESCRIPTION OF A NEW SPECIES OF ERYNNIS (THANAOS AUCT.), (LEPIDOPTERA–RHOPALOCERA–HESPERIIDAE)

BY E. L. BELL
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Erynnis meridianus new species

Male. Upperside. Primaries, dark brown; two darker spots near the base, one in the cell and one below it; a dark spot from the center of the costal margin across the cell; a band of dark spots from the costal margin above the cell-end, curving around and under it and extending to just outside of the center of vein 1, all of these spots are rather indistinct; another dark and more distinct antemarginal band from just before the apex to vein 1, parallel to the outer margin; a pale, minute marginal dot at the vein ends; between vein 1 and the inner margin is entirely dark; lightly overscaled with whitish between the two outer bands; a few scattered scales of the same color in the discal area; a roundish spot in the cell near the end, which may be absent; another between veins 3–4, beyond the cell-end; a smaller one between veins 2–3, below the cell-end, which may be absent; four subapical spots; all of these spots are whitish, semi-hyaline; fringes dark brown.

Secondaries, dark brown, with a hazy indication of a marginal and antemarginal band of paler spots, parallel to the outer margin; fringes dark brown at their base, paler at the ends.

Underside. Primaries, paler than above, between vein 1 and the inner margin very much lighter than the rest of the wing; a marginal and antemarginal band of paler spots, parallel to the outer margin; apex lightly scaled with whitish; semi-hyaline spots of the upper surface repeated; fringes brown, slightly paler at their base, giving the effect of a fine marginal line.

Secondaries, brown, a little paler than above, often with a purplish sheen, very pronounced in fresh, unfaded specimens; the marginal and antemarginal bands of pale spots hazy, as above; fringes brown, paler at the tip, with the fine line at their base, as in the primaries; an occasional specimen shows two very minute white dots near the outer angle, similar to those found in *propertius* Scudder and Burgess and *juvenalis* Fabricius.

Body, above and beneath, brown; head, brown; palpi, brown, intermixed with whitish; legs, brown; antennæ, above, brown, beneath, spotted light at the joints; club, above, brown, beneath, yellowish, tip, reddish. Costal-fold present.

Female. Upperside. Primaries, similar to the male, except that the ground-color is lighter, the bands more distinct, the one around the cell-end composed of streaks and sagittate spots, the whitish overscaling more extensive, giving the wings a more variegated appearance.

Secondaries, same as the male, slightly paler in color, the marginal and antemarginal spots a little more distinct.

Beneath, same as the male, the fine basal line of the fringes more pronounced.

Expanse. Male, 42–46 mm; female, 42–44 mm.

Described from 19 males and 7 females, from Arizona and Texas.

Holotype, male, White Mountains, Arizona, July; allotype, female, Globe, Arizona, May; both collected by Mr. O. C. Poling; deposited in the collection of the American Museum of Natural History, New York City.

Paratypes. Five males, July, 1 female, August, Prescott, Arizona; 1 male, Redington, Arizona; 1 female, Mohave County, Arizona; September, 1 male, 1 female, White Mountains, Arizona; 1 female, Paradise, Arizona; July, 2 males, Kerrville, Texas; 1 male, Shovel Mountains, Texas, May, in collection of Dr. William Barnes, Decatur, Illinois; 1 male, White Mountains, Arizona, July, in collection of Dr. A. W. Lindsey, Granville, Ohio; 4 males, 1 female, Paradise, Arizona, July, 1 male, White Mountains, Arizona, July, 2 males, 1 female, Alpine, Texas, July, in collection of the author.

The specimens in the collection of the author from Paradise, Arizona, were collected by Mr. O. C. Duffner, those from the White Mountains, Arizona, and Alpine, Texas, by Mr. O. C. Poling.

Superficially *meridianus* greatly resembles *horatius* Scudder and Burgess and there does not appear to be any constant characters to separate them in all cases other than the male genitalia, the form of which is quite different in the two species; naturally there is also a resemblance to *juvenalis* Fabricius; *meridianus* is, however, of less contrasty appearance and with the whitish overscaling of the primaries not so heavy and extensive; also the two white spots near the outer angle of the secondaries beneath are usually absent in *meridianus* and usually present in *juvenalis*;

the genitalic form is also different in the two species, that of *meridianus* more nearly resembling the form of *propertius,* but constantly differing in all of the specimens examined; superficially *meridianus* may be separated from *propertius* by the somewhat broader wing shape and the much reduced whitish overscaling.

RECORDS AND DESCRIPTIONS OF NEOTROPICAL CRANE-FLIES (TIPULIDAE, DIPTERA), III.

By Charles P. Alexander
Amherst, Massachusetts

The preceding part under this title was published in 1920 (Journal New York Entomological Society, 28: 1–13). The majority of the species discussed at the present time were included in collections made in Porto Rico by Dr. William A. Hoffman, in Salvador by Mr. Kenneth A. Salman, and in the Canal Zone by Dr. Nathan Banks. A few additional specimens were received from other sources that are mentioned in the text. I wish to extend my sincere thanks to all of the gentlemen who have so generously cooperated in this study of the Tipulidæ of Tropical America. Except where indicated to the contrary, the types are preserved in my collection.

Genus *Limonia* Meigen

Limonia hoffmani new species.

General coloration obscure brownish yellow, the præscutum with three dark brown stripes; antennæ black, the flagellar segments oval with short apical pedicels; legs dark brown, the tips of the femora narrowly paler; wings with a faint dusky tinge, the oval stigma darker brown; male hypopygium with the single dististyle elongate, attached near midlength, the outer lobe obtuse, setiferous, the inner lobe a long slender rod that is narrowed to the acute apex.

Male.—Length about 4 mm.; wing 5.1 mm.

Rostrum and palpi brownish black. Antennæ relatively elongate, black throughout, the flagellar segments oval with short apical pedicels. Head brownish gray, the vertex variegated with darker.

Pronotum dark brown. Mesonotal præscutum obscure brownish yellow with three dark brown stripes, the humeral region brighter yellow; scutum yellowish brown, the lobes extensively dark brown; scutellum dark brown, a little paler at base and apex; postnotum paler brown. Pleura shiny, infuscated, the pteropleurite paler. Halteres pale, the knobs dark brown. Legs with the coxæ and trochanters yellowish testaceous, the fore coxæ darker basally; remainder of legs dark brown, the tips of the femora narrowly but

rather conspicuously paler, the tarsi darker. Wings with a faint dusky tinge, the oval stigma darker brown; cell *Sc* darker than the ground-color; veins dark brown. Macrotrichiæ of veins long and conspicuous. Venation: *Sc* long, Sc_1 ending shortly before the end of *Rs*, Sc_2 subequal to Sc_1; *m* arcuated; cell *1st* M_2 pentagonal; *m–cu* close to the fork of *M*.

Abdomen dark brown, including the hypopygium, the segments narrowly ringed caudally with paler. Male hypopygium with the basistyles elongate, the ventro-mesal lobe relatively small. Dististyle single, very conspicuous, attached by its side, being prolonged caudad into an outer and mesad into a slender inner lobe; outer lobe setiferous, the long gently curved inner lobe narrowed to the acute apex. Gonapophyses with the mesal lobes long, curved, the obtuse apices dusky. Aedeagus broad, the outer end expanded into a head, the apex truncated.

Habitat.—Porto Rico.

Holotype, ♂, Luquillo National Forest, May 10–13, 1927 (W. A. Hoffman).

Limonia hoffmani is named in honor of the collector, my friend, Dr. William A. Hoffman. The species belongs to a characteristic group of Neotropical crane-flies, the closest ally being, apparently, *L. basistylata* Alex. (Jamaica), which differs conspicuously in the structure of the male hypopygium. The present species was associated in collections from the Luquillo National Forest with *Brachypremna unicolor* O. S., *Geranomyia cinereinota* Alex., *Helius albitarsis* (O. S.), *Pilaria triangularis* n. sp., *Gonomyia* (*Lipophleps*) *subterminalis* n. sp., *G.* (*L.*) *bicornuta* n. sp. and *Trentepohlia* (*Paramongoma*) *niveitarsis* (Alex.).

Genus *Geranomyia* Curtis

Geranomyia cerberus new species.

General coloration brownish black, the mesonotal præscutum with the three usual stripes confluent; wings strongly suffused with brown, the stigma darker; abdominal tergites brownish black; rostral prolongation of male hypopygium small, the spines conspicuous.

Male.—Length (excluding rostrum) about 6 mm.; wing 8–8.4 mm.; rostrum about 2.2–2.3 mm.

Female.—Length (excluding rostrum) about 5.5–6 mm.; wing about 6.5 mm.; rostrum about 2 mm.

Rostrum short, black throughout. Antennæ black throughout; flagellar segments oval, or the upper apical angle a trifle produced, the terminal segment longer than the penultimate. Front and anterior vertex gray, the latter

very narrow, strip-like; remainder of head black, the posterior orbits indistinctly pale.

Pronotum dark brown. Mesonotum brownish black, the usual præscutal stripes entirely confluent, the humeral region and narrower lateral margins obscure yellow; median area of the scutum obscure brownish yellow. Pleura dark brown, the dorsal region of the sternopleurite restrictedly obscure yellow. Halteres short, dark brown, the base of the stem narrowly but conspicuously yellow. Legs with the coxæ darkened; trochanters obscure yellow, the tips darker; femora dark brown, only the bases narrowly brightened; tibiæ brown, the apices and the tarsi paling into yellowish brown, this most evident on the posterior tarsi. Wings with a strong brown suffusion, the ill-defined oval stigma darker brown; veins darker than the ground-color. Venation: *Sc* moderately long, Sc_1 ending at near one-third to two-fifths the length of *Rs*, Sc_2 not far from the tip of Sc_1; a weak supernumerary cross-vein in cell *Sc*; *Rs* long; cell *1st* M_2 closed, a little longer than vein M_{1+2} beyond it; *m–cu* close to the fork of *M*.

Abdomen dark brown, the tergites brownish black; hypopygium dark. Male hypopygium with the ventral dististyle large and fleshy, the rostral prolongation very small, the base constricted, the two spines long and conspicuous, placed side by side on two elevated tubercles; spines very gently curved, longer than the apex of the prolongation alone. Dorsal dististyle relatively short, moderately curved, the tip acute. Mesal lobe of the gonapophysis a long, curved acute spine.

Habitat.—Mexico, Guatemala, Costa Rica.

Holotype, ♂, Escuintla, Guatemala, November 12, 1902 (G. Eisen).

Allotype, ♀, Cache, Costa Rica, March 3, 1910 (P. P. Calvert), in the Academy of Natural Sciences, Philadelphia.

Paratype, a broken ♂, Córdoba, Mexico, April 1, 1908 (F. Knab).

Geranomyia cerberus bears a conspicuous resemblance to *G. lachrymalis* Alex., (Ecuador), with which species it was formerly confused in collections. The records for *lachrymalis* (Proc. Acad. Nat. Sci. Phila., 1916: 492; 1916) pertain to the present species. The male hypopygia of the two species are very distinct.

Geranomyia recisa new species.

Resembles *G. scolopax* Alex.; mesonotal præscutum buffy with three narrow dark brown stripes and with the lateral margins darkened; femora with a subterminal brown ring; wings grayish, with a sparse brown pattern; *Sc* short; spines of the rostral prolongation of the male hypopygium relatively short, subequal, arising from short swollen bases.

Male.—Length (excluding rostrum) about 4 mm.; wing 4.7–4.9 mm.; rostrum about 2.2 mm.

Rostrum of moderate length, a little more than half the length of the body, brownish black, the tips paler; palpi brown. Antennæ dark brown throughout. Anterior vertex pale, yellowish; posterior vertex dark gray with two conspicuous black triangular markings that leave a narrow median vitta of the ground-color.

Pronotum buffy with a dark brown median area. Mesonotal præscutum buffy with three narrow but very distinct brown stripes; lateral margins of the sclerite broadly darker than the ground-color but paler than the three intermediate stripes; when viewed from above the præscutum appears to have five dark stripes on a buffy ground; scutum obscure yellow, the lobes pale brown, margined mesially with darker brown, this latter being a caudal extension of the sublateral præscutal stripes; scutellum yellowish testaceous; postnotum brownish testaceous. Pleura yellowish brown dorsally, the sternopleurite clearer yellow. Halteres pale, the knobs dark brown. Legs with the coxæ yellow, the fore coxæ a trifle darker; trochanters yellow; femora brownish yellow, clearer basally, with a broad brown subterminal ring, this about twice as wide as the yellow apex, preceded by a narrower more or less distinct obscure yellow annulus; tibiæ pale brown, the tips slightly darker; tarsi pale brown, the terminal segments darker. Wings with a grayish tinge, with a sparse brown pattern; stigma oval, brown; small brown clouds at origin of *Rs* and on the supernumerary crossvein in cell *Sc*; cord and outer end of cell *1st* M_2 narrowly seamed with very pale brown; a pale marginal cloud on vein R_3 and others at the ends of the anal veins; veins brownish yellow, a little darker in the infuscated areas. Venation: *Sc* relatively short, both Sc_1 and Sc_2 ending just beyond the origin of *Rs*; a weak supernumerary crossvein in cell *Sc*; *Rs* weakly angulated at origin; cell *1st* M_2 closed, relatively long, about equal to vein M_{1+2} beyond it; *m–cu* close to the fork of *M*.

Abdominal tergites dark brown, the sternites brownish yellow; hypopygium darker brown. Male hypopygium with the ninth tergite rather large, narrowed posteriorly, the caudal margin with a broad V-shaped notch, the lateral lobes thus formed obtuse, provided with long coarse setæ. Ventral dististyle large and fleshy, the rostral prolongation rather small and inconspicuous; the two spines are subequal in length, one more strongly curved at base and arising from a swollen base that is a little longer than that of the second spine, the longest of these bases not exceeding one-fourth to one-fifth the length of a spine.

Habitat.—Mexico, Salvador.

Holotype, ♂, Agronomia, Sonsonate, Salvador, in river cañon, altitude 1,500 feet, March 10, 1926 (K. A. Salman).

Paratopotypes, 4 ♂♂, March 20, 1926; paratype, ♂, Córdoba, Mexico, December 1, 1924 (Alf. Dampf).

Genus *Polymera* Wiedemann

Polymera (Polymera) prolixicornis new species.

General coloration dark brown, the mesonotum a little brighter than the pleura; antennæ (♂) very long, binodose; tarsi of all the legs whitened; wings with a strong brown suffusion; Sc_1 ending near midlength of R_{2+3+4}; Rs and R_{2+3+4} subequal or the latter a little longer.

Male.—Length about 5 mm.; wing 5.6 mm.; antenna about 10.5 mm.

Female.—Length about 6 mm.; wing 5.5 mm.

Antennæ of male very long, approximately twice the length of the body, brown, with very long outspreading setæ, the segments not or scarcely paler at the incisures. Head dark brown.

Mesonotum and pleura uniformly dark brown, the lateral pretergites narrowly paler; the dark color of the pleura is somewhat more intense than that of the notum and includes the fore coxæ. Halteres brown, the base of the stem narrowly pale. Legs with the middle and hind coxæ yellowish; trochanters yellow; femora brown, their bases restrictedly paler; tibiæ pale brown, the tips only weakly darker; tarsi of all the legs largely white, on the posterior legs including the entire tarsi, on the other legs the proximal ends of the basitarsi more or less darkened. Wings with a strong brown suffusion, especially in the female, the veins narrowly but evidently seamed with still darker brown; veins dark brown, the macrotrichiæ long and conspicuous. Venation: Sc_1 ending near midlength of R_{2+3+4}, the latter subequal to or a little longer than Rs and about two-thirds R_{2+3}; R_{1+2} about one-half R_{2+3} and not exceeding one-third of the distal section of R_1; cell M_1 very small; cell M_3 moderately deep, a little shorter than its petiole; *m–cu* lying some distance beyond *r–m*.

Abdomen dark brown. Ovipositor with the tips of the elongate valves pale.

Habitat.—Salvador.

Holotype, ♂, Agronomia, Sonsonate, in river cañon, altitude 1,300 feet, January 31, 1926 (K. A. Salman).

Allotopotype, ♀.

The present species comes closest to *P.* (*P.*) *fusca* Wied. (Brazil) in the uniform dark coloration of the thoracic pleura, the whitened tarsi of all the legs and other characters. It differs conspicuously in the venation, Sc_1 ending near midlength of R_{2+3+4}, the latter being about two-thirds as long as R_{2+3}. In *fusca*, Sc_1 ends considerably beyond the origin of R_{2+3}, R_{2+3+4} being relatively short, only about two-fifths of R_{2+3}.

Genus *Pilaria* Sintenis

Pilaria triangularis new species.

General coloration brown; head brownish black, paler anteriorly; flagellum dark brown; wings grayish subhyaline, the small stigma dark brown; cell R_3 small and triangular, much as in species of *Gonomyia*; cell *1st* M_2 open by the atrophy of *m*; *m–cu* at or close to the fork of *M*.

Female.—Length about 5 mm.; wing 5 mm.

Rostrum and palpi brownish black. Antennæ with the scapal segments obscure yellow, the basal five flagellar segments short and crowded, dark brown; remainder of flagellum broken; verticils of the segments of moderate length only. Head brownish black, the anterior vertex paler.

Pronotum obscure yellow. Mesonotum uniformly brown, the præscutum without markings, the lateral margins and humeral region broadly yellowish. Pleura testaceous, with a broad dorsal brownish stripe that includes the dorso-pleural region. Halteres dark brown, the stem a little paler. Legs with the coxæ testaceous, the posterior coxæ with a blackened lateral area; trochanters testaceous; femora and tibiæ pale brown, the tips of the latter a little infuscated; tarsi pale brown, the terminal segments darkened; setæ of legs moderately conspicuous. Wings grayish subhyaline, the base and costal region a little more yellowish; stigma small, oval, dark brown; veins brown, paler in the costal region. Venation: *Sc* short, Sc_1 ending just before two-thirds the length of *Rs*, Sc_2 some distance from the tip of Sc_1, the latter alone approximately equal to *m–cu*; *Rs* strongly angulated at origin; R_{2+3+4} about one-half longer than R_{3+4} and in alignment with it; R_2 subequal to R_{1+2} and about one-half R_{2+3}; R_3 short, oblique, about equal to *m–cu*; R_4 about equal to the combined R_{2+3+4} plus R_{3+4}, cell R_3 being short-triangular, *Gonomyia*-like; cell M_1 lacking; cell *1st* M_2 open by the atrophy of *m*; *m–cu* at or close to the fork of *M*; anterior arculus present.

Abdomen dark brown, the sternites a little paler. Ovipositor with the valves long and slender, horn-colored, the sternal valves darker.

Habitat.—Porto Rico.

Holotype, ♀, Luquillo National Forest, May 10–13, 1927 (W. A. Hoffman).

The reference of this fly to *Pilaria* is provisional only. It seems unquestionably to be related to the Nearctic *lenta* O. S. and allies, the strict generic position of which still remains in question. *Pilaria triangularis* is an even more aberrant species than *P. nacrea* (Alex.) of Jamaica. The very small cell R_3, the open cell *1st* M_2 and the position of *m–cu* close to the fork of *M* are all features that set off the present fly as a very distinct species.

Genus *Eriocera* Macquart

Eriocera (Penthoptera) intermedia new species.

Head dark gray; mesonotum dark ferruginous, without markings; halteres brownish black; legs brownish black, the tarsi conspicuously white, especially the posterior tarsi; wings subhyaline, the apex distinctly infumed.

Female.—Length about 11.5 mm.; wing 11.3 mm. Fore leg, femur, 8.4 mm.; tibia, 10.8 mm.; basitarsus, 8.3 mm.

Rostrum and palpi brown. Antennæ with the scapal segments yellowish brown; flagellum black. Head dark gray.

Mesonotum dark ferruginous, the surface dull, the scutellum somewhat more yellowish; postnotal mediotergite with a depressed subcircular area on either side at base. Pleura obscure ferruginous yellow, the dorsal region a little darker. Halteres brownish black throughout. Legs with the coxæ and trochanters obscure ferruginous; femora brownish black, the bases narrowly obscure yellow; tibiæ black; tarsi white; on the fore legs, about the proximal three-fourths of the basitarsus is darkened; on the posterior legs of the type (♀) the entire tarsi are white; of the paratype, which is presumably a male, the proximal third of the basitarsus is darkened. The legs, and especially the fore legs, are very elongate. Wings subhyaline, the apex distinctly infumed; veins brownish black. Venation: Sc_1 ending about opposite two-thirds the length of R_{2+3+4}, Sc_2 some distance from its tip, Sc_1 alone a little shorter than *m–cu*; R_{1+2} varying from a little longer to a little shorter than R_{2+3}; basal section of R_5 long, subequal to *r–m*, in the paratype; in the type this section is obliterated, R_5 being in alignment with *Rs*; cell *1st* M_2 elongate-rectangular; *m–cu* varying from shortly beyond the base to near midlength of the cell; *m–cu* subequal to the distal section of Cu_1; cell *2nd A* narrow.

Abdominal tergites dark brown; sternites obscure yellow.

Habitat.—Panama.

Holotype, ♀, Barro Colorado, Canal Zone, July 23, 1924 (N. Banks); Museum of Comparative Zoology.

Paratopotype, Sex ?, presumably a male, abdomen broken.

Eriocera intermedia is closely allied to *E. candidipes* (Alex.) of Venezuela and to *E. batesi* (Alex.) of Brazil. It agrees better with the last-named species in the narrow cell *2nd A*, differing in the coloration of the wings and details of venation, especially the position of *m–cu*, the shorter cell *1st* M_2 with the veins issuing from it longer than the cell and in the shorter and broader cell R_2. Compared with *candidipes* the legs are longer and more slender, especially the tibiæ of all the legs. In this group of

species there appears to be a sexual dimorphism in the venation, in the females the basal section of R_5 being very short to lacking, in the males this section being long and distinct.

Eriocera (Penthoptera) melanolitha new species.

Head dark gray; antennal scape obscure yellow, the flagellum black; mesonotal præscutum with three stripes that are narrowly but conspicuously margined with velvety-black; a broad continuous dorso-pleural stripe; wings with a faint brownish tinge, especially beyond the cord; legs chiefly black, the tarsi extensively white; abdominal tergites dark brown, bordered with black, the sternites yellow.

Male.—Length about 8 mm.; wing 8.8 mm.

Rostrum and palpi black. Antennæ with the scapal segments obscure yellow; flagellum black, the extreme base of the first segment paler; flagellar segments decreasing in length and diameter outwardly, densely provided with setæ of moderate length. Head dark gray, narrowly darker medially.

Pronotum light yellow. Mesonotal præscutum with a reddish brown median stripe that shows a bluish or pearly reflection laterally and similar bluish or pearly lateral stripes; all three stripes are margined narrowly but very distinctly with velvety-black; humeral region restrictedly yellow; scutum dark, the lobes brownish black with vague paler centers, the lateral margin of each lobe velvety-black; scutellum dark plumbeous; postnotal mediotergite chiefly plumbeous, the sides more yellowish. Pleura light yellow with a very broad and conspicuous brownish black dorsal stripe extending from the cervical sclerites to the abdomen, passing beneath the wing-root, the halteres surrounded by this stripe; dorsad of the stripe a narrower line of the ground-color. Halteres dark brown. Legs with the coxæ pale yellow; trochanters yellow; femora and tibiæ brownish black, only the extreme bases of the femora on the inner side somewhat more yellowish; tarsi largely snowy-white, the basal two-fifths (fore) or one-third (middle) of basitarsi blackened; hind tarsi broken but presumably a trifle darkened. Wings with a faint brownish tinge, especially beyond the cord, the veins in the latter region appearing to be broadly seamed with this color; no stigmal spot; veins dark brown. Venation: Sc_1 ending about opposite *r–m*, Sc_2 shortly before the fork of *Rs*, Sc_1 alone a little longer than *m–cu*; *Rs* a little shorter than in *conjuncta*; cell M_1 lacking; *m–cu* about equal to the distal section of Cu_1.

Abdominal tergites with the first segment obscure yellow, the remainder dark brown; all segments margined laterally and caudally with brownish black; sternites bright yellow, becoming more obscured on the outer segments.

Habitat.—Guatemala, Salvador.

Holotype, Sex ?, El Salto, Antigua, Guatemala, May 1, 1926 (J. M. Aldrich); United States National Museum.

Paratopotype, Sex ?; paratype, ♂, Agronomia, Sonsonate, Salvador, altitude 1,300 feet, January 31, 1926 (K. A. Salman).

The nearest relative of the present species is *E.* (*P.*) *conjuncta* Alex., likewise from Guatemala, which is more yellowish in color with the black stripes of the mesonotum reduced to spots, without a continuous pleural stripe, with chiefly yellowish legs and with the wing-tip narrowly but conspicuously infumed.

Eriocera semirufa new name.

1923. *Eriocera dimidiata* Alex.; Ent. News, 34: 17–18; 1923; *nec Eriocera dimidiata* Henriksen, Danmarks geologiske Undersøgelse, II Række, Nr. 37: 20, fig. 9, June, 1922.

Dr. Henriksen informs me that separates of his paper on "Eocene Insects from Denmark" were distributed on June 24, 1922. From his figure, the fossil species would appear to belong to *Gnophomyia* or *Psiloconopa*, rather than to *Eriocera*, the great length of the distal section of Cu_1 virtually excluding the species from the Hexatomaria.

Genus *Elephantomyia* O. S.

Elephantomyia banksi new species.

Rostrum relatively very short, only a little more than one-half the length of the body; antennæ black throughout; mesothorax dark ferruginous; wings with a strong brown suffusion; *m–cu* placed at near two-thirds the length of the long-rectangular cell *1st* M_2; abdomen dark ferruginous brown, with a black subterminal ring.

Male.—Length (excluding rostrum) about 6.5 mm.; wing 7.2 mm.; rostrum alone about 3.6 mm.

Rostrum black, only a trifle more than one-half the length of the body; palpi black. Antennæ black throughout, the outer verticils elongate. Head dark brown; anterior vertex relatively wide, more than three times the diameter of the first scapal segment.

Pronotum dark brown. Mesonotum and pleura dark ferruginous, without markings. Halteres dark, the extreme base of the stem narrowly paler. Legs with the coxæ and trochanters yellowish testaceous; remainder of legs black, the femoral bases obscure yellow. Wings with a strong brownish suffusion, the base and costal region narrowly pale yellow; stigma very narrow and elongate, scarcely darker than the ground-color; veins brown.

Venation: *Sc* relatively long, Sc_1 ending shortly beyond the fork of *Rs*, Sc_2 near its tip; *Rs* only about as long as the long-rectangular cell *1st* M_2; cell R_2 at margin more than twice as wide as cell R_4; cell *1st* M_2 longer than vein M_4 beyond it; *m–cu* longer than the distal section of Cu_1, placed at near two-thirds the length of cell *1st* M_2; cell *2nd A* relatively small.

Abdomen dark ferruginous-brown, with a black subterminal ring; hypopygium yellow.

Habitat.—Panama.

Holotype, ♂, Barro Colorado, Canal Zone, July, 1924 (N. Banks); Museum of Comparative Zoology.

Elephantomyia banksi is named in honor of the collector, Dr. Nathan Banks, to whom I am greatly indebted for numerous favors in the past. The species is readily distinguished by the short rostrum, strongly infuscated wings and the other diagnostic features indicated above.

Genus *Gonomyia* Meigen

Gonomyia (Gonomyia) salmani new species.

Male.—Length about 3.5 mm.; wing 4 mm.

Female.—Length about 4 mm.; wing 4.5 mm.

Belongs to the *remota* group, most closely allied *to G.* (*G.*) *brevicula* Alex. (Cuba) from which it differs in the small size and details of coloration and venation. The species of the group have been keyed in a recent paper by the writer (JOURN. N. Y. ENT. SOC., 34: 226; 1926).

Pronotum yellow. Mesonotum dark brown to plumbeous brown, the lateral margins of the præscutum narrowly paler. Dark pleural stripe broad but narrower than the ventral pale vitta; ventral dark stripes on sternopleurite variable in intensity, in some specimens being much darker and more extensive than in others. Halteres dark, the knobs obscure yellow at tips. Wings grayish subhyaline, the stigma darker; a vague dusky cloud on the anterior cord; veins brown. Venation: *Sc* short but still longer than in *brevicula*; Sc_2 at extreme tip of Sc_1; distance on costa between Sc_1 and origin of *Rs* about equal to or only a little longer than *m–cu*, in *brevicula* more than one-half longer than *m–cu*; *Rs* shorter, subequal to the petiole of cell R_3; vein R_3 not so strongly oblique as in *brevicula*; vein R_4 deflected rather strongly caudad at apex, cell R_3 being very wide.

Abdominal tergites dark brown, the basal sternites yellowish; lateral margins of the tergites very restrictedly yellowish. Male hypopygium with the basistyle produced into a very small pale fleshy lobe. Outer dististyle a moderately elongate, relatively slender dusky lobe. Inner dististyle a broad, relatively short dusky blade, the apex obtuse, bearing at its base

a smaller acute spinous blade that lies in the axil of a fleshy setiferous lobe bearing two very large powerful spinous setæ. Aedeagus a sinuous flattened blade, the apex pale and obtuse, the gonapophyses asymmetrical, both strongly curved into acute spines, one apophysis being much larger than the other.

Habitat.—Salvador.

Holotype, ♂, Agronomia, Sonsonate, altitude 1,500 feet, March 19, 1926 (K. A. Salman).

Allotopotype, ♀.

Paratopotypes, ♂ ♂, January 31, March 10–20, 1926 (K. A. Salman).

This interesting *Gonomyia* is named in honor of the collector, Mr. Kenneth A. Salman, to whom I am greatly indebted for many crane-flies from Salvador.

Gonomyia (Lipophleps) subterminalis new species.

Belongs to the *manca* group; antennæ black throughout; mesonotum brown, the postnotum variegated with yellow; pleura striped with pale brown and testaceous; wings with a strong dusky tinge; abdomen dark brown, the hypopygium obscure yellow; male hypopygium with the dististyle bifid, including small basal spine and a large clavate fleshy lobe, the latter bearing a fasciculate seta on the mesal margin before the apex.

Male.—Length about 2.8–2.9 mm.; wing 3.6–3.8 mm.

Rostrum, palpi and antennæ black throughout; flagellar segments with long verticils. Head yellow, the anterior vertex narrow; in one paratype, the head is much darker in color.

Pronotum and lateral pretergites sulphur-yellow. Mesonotal præscutum brown, the humeral region restrictedly pale yellow; scutum with the median area in front yellow, darker behind, the lobes extensively infuscated; scutellum brown basally, obscure yellow apically; postnotal mediotergite light sulphur-yellow on the cephalic half, more reddish on the posterior half. Pleura striped with brown and testaceous, including a testaceous stripe extending from the cervical sclerites, passing beneath the halteres, the subtending dorsal and ventral stripes darker brown; dorsal half of the pleurotergite bright sulphur-yellow. Halteres pale brown, the knobs broken. Legs with the coxæ and trochanters testaceous; remainder of legs brown. Wings with a strong dusky tinge, the base and costal region a trifle brighter; centers of the cells a little brighter than the broad seams to the veins; veins dark brown, paler in the costal region. Veins beyond the cord with conspicuous macrotrichiæ. Venation: Sc short, Sc_1 ending a distance before the origin of Rs that is a little shorter than m–cu; Sc_2 close to the tip of Sc_1; cell *1st* M_2 closed; m–cu at fork of M.

Abdomen dark brown, the hypopygium and subterminal sternites obscure yellow. Male hypopygium with the outer lobe of the basistyle longer than the dististyle, fleshy. Dististyle bifid, including a pale basal spine and a long clavate fleshy lobe that is shorter and more slender than the outer lobe of the basistyle; before apex of the style, on the mesal margin at near three-fourths the length, a powerful fasciculate bristle or spine. Phallosome massive, terminating in a median spine (ædeagus ?) and pale hairy lateral lobes; the ædeagus is subtended on either side by a small lobe that terminates in a tuft of three or four spinous bristles.

Habitat.—Porto Rico.

Holotype, ♂, Luquillo National Forest, May 10–13, 1927 (W. A. Hoffman).

Paratopotypes, 2 ♂♂.

Gonomyia (Lipophleps) bicornuta new species.

Belongs to the *manca* group; general coloration brown and sulphur-yellow; rostrum and antennæ black; pleura with a broad whitish longitudinal stripe; knobs of halteres yellow; wings brownish gray, without a stigma; cell *1st* M_2 closed; male hypopygium with the dististyles symmetrical, appearing as relatively small curved black horns.

Male.—Length about 2.2 mm.; wing 2.6 mm.

Rostrum, palpi and antennæ black. Head dark, the orbits a little brighter.

Pronotum and lateral pretergites light sulphur-yellow. Mesonotal præscutum brown, sparsely pruinose, the humeral region restrictedly yellow; scutum light yellow medially, each lobe virtually covered by two confluent dark brown areas; scutellum light yellow with a brown median spot at base; postnotal mediotergite yellow with an extensive dark brown triangular basal area and a paler reddish brown posterior marking. Pleura chiefly dark, with a broad distinct white or yellowish white longitudinal stripe extending from the fore coxæ, passing beneath the root of the halteres; dorso-pleural region obscure brownish yellow; dorsal portion of the pleurotergite brighter yellow; sternopleurite and meron somewhat more pruinose. Halteres dark, the apices and the knobs yellow. Legs with the coxæ and trochanters pale; remainder of the legs broken. Wings with a brownish gray suffusion, more or less variegated longitudinally with paler washes; stigma lacking; costal region narrowly pale yellow; veins pale brown. Venation: *Sc* relatively long, Sc_1 ending about opposite the origin of *Rs*, Sc_2 a short distance from its tip, Sc_1 alone more than one-half *m–cu*; cell *1st* M_2 closed; *m–cu* close to the fork of *M*.

Abdominal tergites dark brown, brighter laterally; sternites paler. Male hypopygium with the basistyles stout, the outer apical angle produced into a small blunt fleshy lobe. Dististyle simple, those of the two sides sym-

metrical, each appearing as a relatively small, powerful, heavily blackened, curved horn arising from an expanded base. Phallosome relatively large, the ædeagus bilobed at apex, subtended on either side by a small blackened rod, on slide mounts these latter decussate on the median line.

Habitat.—Porto Rico.

Holotype, ♂, Luquillo National Forest, May 10–13, 1927 (W. A. Hoffman).

Genus *Neognophomyia* Alexander

Neognophomyia trinitatis new species.

General coloration yellow, including the postnotal mediotergite; thoracic pleura with a conspicuous dark brown spot on the anepisternum; wings subhyaline, with a single narrow brown crossband on the anterior cord.

Male.—Length about 4.2 mm.; wing 5 mm.

Rostrum yellow, the palpi brown, the bases of the individual segments narrowly obscure yellow. Antennæ with the scapal segments obscure yellow; flagellum broken. Head bright yellow, the genæ a little more obscure.

Mesonotum shiny ferruginous yellow without markings, the center of the scutum and the scutellum a little more testaceous. Pleura obscure yellow, the anepisternum largely covered by a roughly oval dark brown marking, the pteropleurite pale; a paler brown mark on the pleurotergite, just cephalad of the halteres. Halteres yellow, the knobs a little darker. Legs with the coxæ pale yellow; trochanters a little more ferruginous; remainder of legs yellow with long pale setæ, the terminal tarsal segments darkened. Wings grayish subhyaline, the base and costal region a trifle more yellowish; a narrow and relatively inconspicuous brown crossband extending from the costal margin along the anterior cord to *r–m*; veins pale brownish yellow, the cord and outer end of cell *1st* M_2 darker. Venation: *Sc* long, Sc_1, R_{1+2} and R_3 all close together at costa; Sc_2 far from the tip of Sc_1, the latter only a little shorter than *Rs*; R_3 very oblique, the cell correspondingly widened; cell *1st* M_2 short, *m–cu* at near one-third its length.

Abdomen yellow, the tergites a little infuscated laterally. Male hypopygium with the inner dististyle very strongly arcuated. Phallosome expanded into an oval flattened structure, the subtending wings of the ædeagus being very widely expanded. The rods on the mesal sides of the basistyles that appear to be interbases appear as elongate, very slender rods that narrow gradually to their tips.

Habitat.—Trinidad.

Holotype, ♂, Port of Spain, February 7 (W. S. Brooks).

I am very greatly indebted to Mr. Johnson for this interesting specimen. *Neognophomyia trinitatis* is allied to *N. immaculipen-*

nis (Alex.) of Paraguay (Ann. Ent. Soc. America, 19: 391–392; 1926), differing in the coloration and the structure of the male hypopygium. The homologies of the parts of the male hypopygium in this genus require more study.

Genus *Erioptera* Meigen

Erioptera (Erioptera) quinquecincta new species.

Allied to *E.* (*E.*) *annulipes* Will.; tibiæ with four dark and five white annuli, the first dark ring subbasal in position; vein *2nd A* sinuous, the apex simple.

Male.—Length about 3.5–3.6 mm.; wing 3.6–3.7 mm.

Allied to *E.* (*E.*) *annulipes* Will., differing especially in the leg-pattern. Head pale. Mesonotum reddish brown, the anterior lateral pretergites almost white; scutellum whitish; postnotum sparsely dusted with gray. Pleura with the silvery stripe distinct. Halteres pale. Legs as in *annulipes;* femora with four brown rings that increase in size outwardly, the tips pale; tibiæ white with four narrow brownish black rings that are a little more extensive than the white interspaces on the fore legs but much narrower than these interspaces on the posterior legs; basal and apical rings of the tibiæ white so there are five white annuli alternating with the black rings; tarsi as in *annulipes,* the dark basitarsal annuli subequal to the white one on the fore tarsi, much narrower on the posterior tarsi; second tarsal segment white, the tips conspicuously blackened. Wings with the brown pattern relatively restricted; vein *2nd A* strongly sinuous, the tip simple. Abdomen reddish brown to yellowish brown, the hypopygium pale.

Habitat.—Colombia.

Holotype, ♂, Caldas, altitude 4,400 feet, December 9, 1914 (H. S. Parish).

Paratypes, 2 ♂♂, Cali, altitude 3,500 feet, May 23, 1914 (H. S. Parish).

A SYSTEMATIC INDEX TO THE KEYS FOR THE DETERMINATION OF THE NEARCTIC COLEOPTERA*

BY MELVILLE H. HATCH

Adequate analytical keys are scarcely less important to the progress of coleopterology than are the original descriptions. The following index has been drawn up with the object of facilitating reference to the extant keys for the determination of families, genera, and species of the Coleoptera of America north of Mexico.

The several systematic groups are arranged in the sequence of the Leng (1920) ''Catalogue of the Coleoptera of America north of Mexico'' and are followed by brief bibliographical references which involve the author's name, the last two figures of the year of publication, and a page number which refers either to the first page of the paper containing the key or to the first page upon which the key actually begins. The complete reference is to be obtained either from the bibliography (to Jan. 1, 1919) on pages 367 to 444 of the Leng (1920) ''Catalogue'' or from the supplementary bibliography at the end of this index. The abbreviation ''G.I.'' followed by a figure indicates a fascicule of Wytsman's *Genera Insectorum,* which is not further mentioned in the bibliography.

Further information concerning the scope of the key is given in parentheses after the page number. If no such notation occurs, it is to be understood that the key is to *all* the *species* of *adults* known to its author for the *entire* Nearctic area north of Mexico *previous to the date of publication.* The key may be limited by being only to the species of a part of the group or genus, a subgenus, a group of species or the species of a particular geographical region. It may further be limited by being only to families, genera, or subgeneric groups. Finally, it may be a key to some

* A contribution from the Department of Zoölogy of the University of Minnesota.

other than the adult stage, as to eggs, larvæ, or pupæ. In view of the paucity of keys to larvæ and the similarity of the Nearctic and Palæarctic genera, European as well as American keys to genera of larvæ have frequently been included. Larval keys to genera rarely exhaust the genera of the group under consideration. Some of the earlier keys by Leconte and others did not go further than to groups of species, whereupon one must read through a series of specific descriptions to make a determination. Such keys are designated, in part, as ''imperfect.''

The more inclusive papers are indexed but once, so that, if one desires to ascertain the keys that exist for any particular genus, he must not only consult that genus, but look for possible references under the tribe, subfamily, family, and series, as well as the group of references preceding Adaphaga at the beginning of the index.

The student must always remember that he will find keys to genera in Leconte and Horn (1883), keys to species inhabiting Indiana, exclusive of the Rhyncophora, in Blatchley (1910), keys to the species of most of the genera of Rhyncophora in Leconte and Horn (1876), and keys to the species of Rhyncophora of eastern North America in Blatchley and Leng (1916). Furthermore, the student should generally use the most recent key and check it against species or groups not included in it, especially such as have been described since its publication.

The aim of the index has been practical, and little effort has been made to go back of Leconte and Horn or to include references of primarily historical interest. The bibliographies in Blatchley's ''Coleoptera of Indiana,'' Blatchley and Leng's ''Rhyncophora of North Eastern America,'' and the bibliographical references in Leng's ''Catalogue of the Coleoptera of America north of Mexico'' have been used, but especial acknowledgment must be made to the bibliography by Henshaw in the back of Leconte and Horn's ''Classification of the Coleoptera of North America'' (1883), its supplement in the back of Henshaw's ''Third Supplement to the List of the Coleoptera of America north of Mexico'' (1895), and Bank's ''List of Works on North American Entomology'' (1910), all of which were drawn up to serve somewhat the same purpose as the present index. The

author is further indebted to Professor Paul S. Welch for calling his attention to some of the references to larvæ.

It is hoped that it may be possible to issue periodic supplements to this index which will include new keys as they appear as well as old references that have been overlooked in the preparation of the present work. The author will appreciate having omissions and errors called to his attention.

COLEOPTERA Leconte and Horn 83 (genera), Hayward 09 (fam.), Brues and Melander 15: 30 (fam.) Comstock 25: 467 (fam.), Essig 26: 369–521 (fam.), Lec. 69: 251 (fam. of Rhypophaga), Pierce 16: 462 (superfam. of Phytophaga), Leng 20: 15–16 (series), MacGillivray 03: 289 (fam. of larvæ), Schiödte 61–83 (many keys to larvæ: not seen), Kuhnt 13: 1091 (fam. of Cantharoid larvæ), Seidlitz 98: 312 (fam. of larvæ of Lagriidæ, Pyrochroidæ, Pythidæ).

COLEOPTERA GENUINA Blatchley 10 (Ind.).

COLEOPTERA AQUATIC Needham 18: 937 (genera of adults, fam. of larvæ), Wilson 23: 268–71 (fam. and genera of larvæ and pupæ of Iowa).

ADEPHAGA Horn 67: 153 (fam.), Fowler 12: 51 (fam.), Notman 25: 4 (fam.), Ganglbauer 92: 4 (fam. of larvæ).

CICINDELIDÆ Schaupp 83: 73, Leng and Beutenmüller 94: 87–96 (n. e. N. A.), Horn 08–15: G. I. 82 (genera), Hamilton 25: 1 (larvæ). AMBLYCHEILA Csy. 24: 2. OMUS Horn and Schaupp 78: 6, Csy. 98: 288, 09: 255, 14: 1, 16: 20 (*hornii* group). CICINDELA Lec. 57: 27, Csy. 13: 27 (*12-guttata* group), 14: 17 (*longilabris* group), 97: 294 (*Dromochorus*), Wickham 94: 151 (Ont., Que.), Blanchard 23: 412 (Cheyboygan and Emmet Co., Mich.).

CARABIDÆ Horn 81: 91 (genera), van Emden 19: 3–33 (genera of larvæ), 21: 128 (genera of larvæ).

Carabinæ Leng and Beutenmüller 94: 135–141, 175–190 (n. e. N. A., no key to genera).

Trachypachini Horn 78: 30, Csy. 20: 144, Van Dyke 25: 112.

Cychrini Horn 78: 168, Schaupp 79: 79, Lec. 68: 60 (Pacific), Rœsche 07: 9–277. NOMARETUS-MARONETUS Schwarz 95: 269. PEMPHUS Csy. 97: 338. BRENNUS Csy. 97: 307, 20: 183 (*cordatus* group). NEOCYCHRUS Van Dyke 24: 6.

Carabini: CARABUS Horn 76: 247, Lec. 78: 66. CALOSOMA-CALLISTHENES Lec. 78: 64, Burgess 17: 17 (adults and larvæ). CALLISTHENES Csy. 20: 164 (*pimeloides* group), 13: 70 (*luxatus* group).

Elaphrini Horn 78: 29 (except species of *Elaphrus*). ELAPHRUS Horn 76: 246, Schaupp 78: 6. BLETHISA Horn 76: 247.

Loricerini Horn 78: 29, Van Dyke 25: 114, Rousseau 08: G. I. 86 (genera).

Opisthiini Horn 78: 30, Dupuis 12: G. I. 126 (genera).

Notiophilini Horn 76: 247, 78: 30, Fall 06: 82, Dupuis 12: G. I. 134 (genera).

Nebriini Bänninger 25: 180, 256, 329 (groups). PELOPHILA-NEBRIA Horn 70: 97, Lec. 78: 473, Schaupp 78: 45, 63.

Metriini Van Dyke 25: 123, Dupuis 11: G. I. 116 (genera).

Promecognathini Schaupp 79: 15, Csy. 13: 93, Rousseau 08: G. I. 84 (genera).

Scaritini Lec. and Schaupp 79: 15–18, 31–34, 59. PASIMACHUS Lec. 74: 266 (imperfect), Csy. 13: 76, Leng 15: 567 (Fla.). SCARITES Leng 15: 568. CLIVINIA-ARDISTOMIS Lec. 57: 75 (no keys to genera, keys imperfect). CLIVINIA Horn 81: 7 (groups), Fall 22: 161 (groups).

Harpalinæ Bisetosæ: **Panagæini** Lec. 79: 59, Leng and Beutenmüller 95: 73 (n. e. N. A.).

Psydrini Dupuis 12: G. I. 123 (genera).

Bembidiini Lec. 57: 2 (groups), Csy. 18: 1. BEMBIDION (s. lat.) Hayward 97: 32, Fall 10: 94 (*littorale* group), Notman 19: 296 (*muscicola* group). TACHYS (s. lat.) Hayward 99: 191.

Pogonini-Pogonini veri Horn 82: 47–48. PATROBUS-PLATIDUS Horn 75: 130, Csy. 18: 395, 398. PATROBUS Leng and Beutenmüller 95: 74 (n. e. N. A.). TRECHUS Schæffer 01: 209, Leng and Beutenmüller 95: 76 (n. e. N. A.), Csy. 18: 405, Jeannel 27: 113, 146–156, 167, 185. NEAPHÆNOPS-

PSEUDANOPHTHALMUS (*Anophthalmus*) Horn 68: 126, 71: 329, 83: 270.

Pterostichini Lec. 52: 225, Wickham 95: 180–190 and 96: 42 (n. e. N. A., no key to genera), Csy. 18: 320 (genera). MYAS Schaupp 82: 63, Csy. 18: 326. HOLCIOPHORUS Horn 80: 50, Csy. 13: 96. CYLINDROCHARIS Csy. 18: 327. PTEROSTICHUS (s. lat.) Lec. 73: 302, Schaupp 82: 15, Csy. 13: 100–129 (parts). LEPTOFERONIA Horn 91: 33 (*Pterostichus*). GASTRELLARIUS-EVARTHRUS Csy. 18: 339–358. GASTRELLARIUS Horn 91: 34 (*Pterostichus*). EVARTHRUS (s. lat.) Lec. 73: 318, Schaupp 80: 21, Wickham 95: 189 (n. e. N. A.). EVARTHRINUS Csy. 20: 194. FERESTRIA Csy. 20: 191. EUFERONIA Csy. 18: 365. GASTROSTICTA Csy. 18: 371. LOPHOGLOSSUS Schaupp 80: 49, Csy. 13: 143. PARARGUTOR Csy. 18: 377. BOTHRIOPTERUS Csy. 13: 138. LOXANDRUS Lec. 52: 250, 78: 375. Schaupp 80: 19, Csy. 18: 380.

Amarini Lec. 55: 346 (imperfect), Wickham 96: 33–42 (n. e. N. A.), Hayward 08: 13 (except *Celia*), Csy. 18: 225 (genera). BRADYTUS-TRIÆNA Csy. 18: 235–314. BRADYTUS Horn 75: 128. CELIA Horn 92: 19. AMARA Horn 75: 127. TRIÆNA Horn 92: 18.

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13: 191 (*aphelogenia* group), 20: 240–252 (parts), 20: 262 (*Dianchomena*). DROMIUS-BLECHRUS Csy. 20: 268–277. AXINOPALPUS Csy. 20: 265. PHILOPHUGA Csy. 13: 173. PINACODERA Csy. 20: 279. CYMINDIS Csy. 13: 178.

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DYTISCIDÆ Crotch 73: 383 (imperfect), Sharp 82: 179, Wickham 95: 70–76, 117–122, 149–153 (Ont., Que.), Zimmermann 19: 68 (genera). CANTHYDRUS Blatchley 19: 308 (Fla.). LACCOPHILUS Horn 83: 283. BIDESSUS Fall 17: 167 (*pictodes* group), Leng and Mutchler 18: 82 (Fla.). **Hydroporini** Lec. 55: 290. CŒLAMBUS Fall 19: 1. HYDROPORUS Fall 23: 1, 26: 141 (*12-lineatus* group). AGABUS Fall 22: 3. COLYMBETES Lec. 62: 521 (imperfect).

GYRINIDÆ Lec. 68: 365 (imperfect), Leng and Mutchler 18: 95–97 (Fla.), Regimbart 02: G. I. 1 (genera), Hatch 25: 110 (larvæ). DINEUTUS Roberts 95: 279, Hatch 25: 447 (subgenera), 26: 344 (subgenera), 27: 28 (Mich. larvæ), Ochs 26: 64 (subgenera). GYRINUS Fall 22: 275.

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BRATHINIDÆ Hubbard 94: 10.

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ELATERIDÆ Lec. 53: 405, Schwarz 06–07: G. I. 49 (genera of part), Perris 77: 185 (genera of larvæ), Forbes 94: 31 (genera of larvæ), Kuhnt 13: 1107 (genera of larvæ), Henriksen 13: 43–48 (larvæ of Danish species). ADELOCERA Horn 79: xiv. CHALCOLEPIDIUS Fall 98: 239, Csy. 07: 29. OISTUS Hyslop 17: 127. PYROPHORUS Hyslop 17: 3–6. LUDIUS Horn 71: 319 (*Corymbites;* groups). HEMICREPIDIUS Horn 80: 69 (*Asaphes*). **Hypnoidini** Horn 91: 1–31. PARALLELOSTETHUS, CRIGMUS Horn 84: 46 (*Ludius*). AGRIOTES Lec. 84: 15. DRASTERIUS Lec. 84: 4. ELATER-ECTAMENOGONUS Lec. 84: 8. ELATER Horn 71: 307 (part). MEGAPENTHES Lec. 84: 6. CARDIOPHORUS Blanchard 89: 4. HORISTOMUS Horn 84: 34. ESTHESOPUS Horn 84: 41.

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CATOGENUS Csy. 16: 114. NARTHECIUS Csy. 90: 322. INOPEPLUS-LAEMOPHLŒUS, DYSMERUS Csy. 16: 118 (genera and subgenera). LAEMOPHLŒUS Csy. 16: 127 (*Silvanophlœus*). **Brontini** Csy. 90: 498 (genera).

EROTYLIDÆ Lec. 54: 158, Crotch 73: 349, Wickham 94: 339–342 (Ont., Que.). **Languriinæ** Fowler 08: G. I. 78 (genera). LANGURIA Schæffer 04: 198. **Erotylinæ** Kuhnt 09: G. I. 88 (genera). DACNE Csy. 16: 153.

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A MUCH-ABUSED BUT STILL CHEERFUL CRICKET

BY FRANK E. LUTZ

In the course of some experiments being conducted jointly by the American Museum's Station for the Study of Insects and Mr. Alfred L. Loomis in the latter's private laboratory of physics at Tuxedo, N. Y., it happened that an individual male cricket had a series of experiences that seem to give him first place among six-footed adventurers. If any other insect wishes to claim the honor, let it first match the following.

On June 21 at 9:38 A. M., this cricket was put into a bell-jar when the barometer outside was reading 742 mm. In two minutes the pressure in the jar was only 220 mm. but the cricket was moving normally. During the next five minutes the pressure in the cricket's jar dropped to 200 mm. If a man had been shot in seven minutes to the altitude represented by that pressure (conservatively, ten miles above sea-level) he would have had little interest in affairs. At first the cricket was very quiet but a quarter of an hour later it was "cleaning" one hind leg and subsequently the other. It still seemed unconcerned forty minutes after its "ascension." Then the tube to the jar was cut and, of course, there was an instantaneous drop to the starting pressure but the cricket merely gave a little twitch as though someone had frightened him a bit.

After a rest of about forty minutes the cricket entered a tank analogous, let us say, to caissons used in submarine work or digging tunnels under the Hudson River; only, in this case, a pressure of about three atmospheres was turned on fairly rapidly and released with a bang when the stopper of the tank blew out. The stopper was replaced more tightly and for ten minutes the cricket was in compressed air of from two to three atmospheres before being once more suddenly released without going through the gradual "decompression" so necessary to human beings in order to avoid "bends." So far as could be seen, Gryllus paid less attention to these events than he did to those of the preceding hour.

The next day was a busy one for our hero. First, he was put head-down in a centrifuge and whirled 1,200 revolutions per minute for ten minutes. When the machine stopped he was tightly wedged in the pointed end of his tube but, rather amusingly, the first thing that he did when shaken out was to chirp. Perhaps he was relieving the strain on his shoulders.

Sound waves are mechanical vibrations. Certain of them, transmitted through air, affect our ears in such a way that we perceive them. The shorter the waves, the shriller the sound until finally the waves are too short to give us any auditory sensation. Mr. Loomis has apparatus for generating waves so short that they are about ten octaves above the shrillest that we can hear. Air will not transmit these "supersonic waves" but they will pass through water and, if a fish gets in their path, it is killed by them. They are the "death whisper" of which newspapers carried accounts some time ago.

After its wild merry-go-round ride, the cricket was put into a dry beaker and the beaker was set in water through which supersonic waves were passing. Apparently it could feel the vibration by its feet, since, however quiet it had been, it moved as soon as the waves started and it stopped when they did. This may (but more probably does not) have a bearing on "audition" by insects.

In order to administer a really good dose of supersonic waves, Gryllus was next put in a beaker of water through which they were traveling. It naturally objected to this submersion but, unlike fish, it seemed undisturbed by the "death whisper," for, when dried, it revived perfectly.

The last experience was the worst of all. It was with radio waves only four meters long. These killed its brother in one minute and a half but a cricket that had bravely withstood high and low atmospheric pressures within an hour of each other, that had been stood on its head and whirled at a high rate of speed and that had been half-drowned in water vibrating with supersonic waves deserved some consideration. We gave it only one minute of four-meter radio waves and to-night (July 2) it is chirping cheerfully in its cage and possibly not thinking at all about its experiences of last week. Still, who knows?

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF MAY 18, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M., on May 18, 1926, in the American Museum of Natural History; President Frank E. Lutz in the chair with seventeen members and eight visitors present.

Mr. George B. Wilmott, 1138 E. 37th Street, Brooklyn, and Mr. William M. Savin, 52 Broadway, New York City, were elected members of the Society.

Mr. Angell spoke on "Early Spring Collecting Experiences in North Carolina," illustrated by specimens of the insects he had found between April 9 and 26. His intention had been to visit Roanoke Island but, being deterred by local reports of the bad weather there, he had collected in the vicinity of Elizabeth City, where especially on the Weeksville Road and on the drift-covered banks of the estuary called Pasquotank River, he had found an abundance of beetles. Four days were spent at Washington, N. C., at the head of the Pamlico River in Beaufort County, where, under the bark of dead oaks, beetles were even more abundant. The beetles exhibited were largely Carabidæ, including *Pasimachus*, *Carabus* and a small series of *Loxandrus.*

Mr. Angell dwelt somewhat upon the meager hotel accommodations at Elizabeth City, the prospects of even worse at Manteo, six hours sail across the Albemarle Sound, and the hospitality of Mr. F. W. Hollowell, whose colonial mansion he was fortunately able to visit.

Mr. Davis spoke of the late Capt. Wainwright, formerly of Staten Island and later of Elizabeth City, whose extensive collections are unfortunately not at present available.

Mr. Huntingdon spoke of *Papilio ajax* and *troilus* smaller than the usual sizes.

Mr. Chapin referred to a newspaper article in which the gathering of 7,760 tent caterpillars by one young person was described.

Mr. Ragot described an Ailanthus tree on Staten Island from which he had taken 225 Cynthia cocoons, twenty-five in one bunch, which he exhibited. He also spoke of collecting in a meadow near Corona, Long Island, where thirty species of beetles were found in a few hours. Among them was a *Calosoma calidum* which devoured seven cut-worms.

Mr. Weiss spoke of having arranged to provide nineteen fire wardens with nets and cyanide jars with a view to obtaining some information on the insects flying at the height of their stations.

Mr. Davis exhibited a female *Schistocera americana* Drury taken on Todt Hill, Staten Island, May 8, 1926. He stated that this large grasshopper was not known to breed as far north as Staten Island, but flies up along the coast. Since 1882 he had recorded the insect on Staten Island on fifteen occasions usually in the fall months, the dates being from September 18 to December 28. On but three other occasions has it been recorded from the Island as early as the month of July.

Mr. Sherman spoke of the extraordinary accumulation of books and pamphlets by a Mr. Burger, of Brooklyn, which were piled up in a garage four feet high.

Mr. Nicolay spoke of finding *Elaphrus clairvillei* at Orangeburg on a muddy bank; also of a trip from Barnegat to New Lisbon, in the course of which *Rhinomacer pallipennis* was found on the flowers of pine.

Messrs. Shoemaker, Shannon, Bell, and Anderson also spoke briefly of the cold April having retarded the appearance of certain butterflies. No record for *Anosia plexippus,* for instance, was forthcoming.

Meeting of October 5, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M., on October 5, 1926, in the American Museum of Natural History; President Frank E. Lutz in the chair with twenty-four members and eight visitors, including C. L. Pollard and Herbert Barber.

Dr. Lutz and Mr. Sherman reported that the Woodruff collection and part of the books were in the museum; that all the books had been appraised, and that the balance of them would soon be shipped to the museum.

Mr. Davis announced the death on October 4, 1926, in her 89th year, of Mrs. Annie Trumbull Slosson, one of the founders of the Society and its steadfast friend for the thirty-four years of its existence. Mr. Davis was requested to prepare an obituary with portrait for the JOURNAL and the secretary was instructed to write Dr. and Mrs. B. B. Gallaudet, Hotel Irving, her surviving relatives, an expression of the Society's appreciation of her service to Entomology and regret for her death.

The President called for reports on summer collecting. Mr. Charles Louis Pollard, present as a visitor, spoke of his observations on a colony of wasps, *Chlorion ichneumonea,* which invariably provisioned its nest with green grasshoppers, *Orchelimum* and *Conocephalus.* His observations were corroborated by Mr. Davis.

Mr. Herbert S. Barber, of the U. S. National Museum, exhibited a specimen of *Dorcus nanus* Csy., ♂ taken at Cape Henry, Va., September 4, by Mr. George P. Engelhardt; and of *Nanosella fungi,* perhaps the smallest of beetles which, in the larval and adult stage, feeds in the vertical spore tubes of polyporus fungi.

Mr. Sherman described his summer visits to Ithaca, Quebec, Truro, Halifax, St. John, and Boston, always with the entomological libraries as his principal object.

Mr. Hall had visited the mountains of Wyoming again and had found August 18 too late at the altitude of 7,000 feet for successful collecting.

Messrs. Barber, Bell, Schwarz and Watson had found collecting poor, though a comparative abundance of *cardui* and *interrogationis* was reported by Mr. Watson.

Mr. Herbert Johnson had had some experience with gypsy moth at Woods Hole and with the preying mantis near Aberdeen, Md. He questioned the value of the mantis as a caterpillar hunter, its principal food being, in his experience, grasshoppers.

Messrs. Sheridan, Campbell, Mutchler, Dr. and Mrs. Hussey, spoke briefly.

Mr. H. F. Schwarz, whose summer had been spent at Fire Island, gave an interesting account of the wasps building in its sands, often abandoning a half-finished attempt, until the sand seemed, with its numerous punctures, like a pin cushion.

Dr. Melander had spent the summer getting acquainted with some eastern collecting grounds, Washington, D. C., and Woods Hole especially. Notwithstanding the capture of some 3,000 specimens he found the collecting not as rich as in Washington state.

Mr. Huntingdon had been very successful early in July in finding *Chrysaphanus epixanthe* in one corner of a cranberry bog at Lakehurst. In August he had visited a ranch in southeastern Wyoming and with E. J. Oslar in Denver. He described Mr. Oslar as a little Englishman 5 feet 4 or 5 inches tall, 69 years old, but slim, wiry and possessed of a great collection and eleven children.

Mr. Shoemaker's report, as usual, showed great activity. Greenwood Lake in June with Mr. Nicolay, Canadensis in the Pocono Mts. in July and September, with the big sweep net working the right hand side of the wood road going, the left side returning, while the thirty-seven bait bottles and the sugared trees were doing their part. One thousand beetles, selected for their special interest, rewarded these efforts; ninety-seven moths in one night, after killing off the common ones, helped to make what Mr. Shoemaker called a pretty good season. Noteworthy captures were seven *Limenitis ursula albofasciata,* all males, and the dark form of *Catocala relicta.* An interesting episode was a convention of katydids on September 20.

Mr. Nicolay, too, reported a successful summer with visits to Lake Surprise, Greenwood Lake, where many buprestids were beaten from scrub pine, to Long Beach, to Point Pleasant and to Fairfax County, Va. *Ardistomis obliquus, Cychrus shoemakeri, Pasimachus sublævis,* and other interesting beetles were mingled in Mr. Nicolay's report with fish hawks and a widow in bathing costume.

Mr. Olsen gave a thrilling account of his Bahama experience in the hurricane of July 25, and of his visit to Woods Hole where he again found a bruchid on Scotch Broom. He had also received an interesting South American collection of jassids, etc., from Dr. Bequaert, on which he will report later.

Mr. Chapin described, among other summer experiences, the effect of wasp sting on a katydid, the latter showing life for three weeks after being stung.

Mr. Willmott spoke of his entomological microscopic slides which he will exhibit later in the season.

Mr. Hartzell spoke of the occurrence of the oriental peach moth *Laspeyresia molesta* in Yonkers, N. Y., and exhibited specimens of *Autoserica japonica* which were taken in that vicinity during the summer. He also reported the presence of a recently introduced gall-forming mite *Eriophyes eucricotes* on *Lycium chinensis.*

Mr. Wm. T. Davis exhibited specimens, including two living males, of the grasshopper *Melanoplus differentialis* Thomas, from near Old Place, Staten Island, the only known locality for the species in the State of New York, first reported in this JOURNAL for December, 1924, and also mentioned in the *Bulletin of the Brooklyn Entomological Society,* December, 1925. He stated that he had lately visited the colony several times, and on the 30th of September, in the company of Dr. Frank L. Campbell, of New York University, and two of his students. It is interesting that the grasshoppers occupy a rather definite zone in the southwesterly side of the high embankment of the railroad. They extend a little way up its side, but are not very often found on top of the highest parts of the embankment, and they very seldom occur out on the adjacent salt meadow. In one place they are somewhat abundant in a thick tangle of matrimony vines. The allied *Melanoplus bivittatus* is much more generally distributed in the vicinity. The specimens of *differentialis* from Staten Island are much darker in color than those from the western part of its range in Colorado, Texas, etc.

Mr. Davis also stated that among butterflies *Melitœa phœton* Drury had been more plentiful on Staten Island during June than he had known it before; *Pyrameis cardui* was also common, while the Monarch butterfly was comparatively scarce. A few were seen flying southward along the shore of the Island on the 30th of August.

MEETING OF OCTOBER 19, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M., on October 19, 1926, in the American Museum of Natural History; Vice-President Henry Bird in the chair, with twenty members and three visitors present.

A letter from Dr. Stephen Breuning, Vienna, soliciting exchanges, was read.

Dr. Frank L. Campbell, New York University, was elected a member of the Society.

On motion by Mr. Mutchler, the meeting scheduled for November 2, being Election Day, was suspended.

Mr. Bell spoke of "Collecting in North Carolina and Virginia," being a narrative of a successful attempt to find the Hesperid butterfly *Problema bulenta* near Wilmington, N. C., and *Amblyscirtes carolina* in the Dismal Swamp near Suffolk, Va. *Bulenta* was found beside a road running through swamps and old rice fields across the Cape Fear River from Wilmington in July. Other localities, including the beach at the mouth of the river, were visited but the fourteen specimens of *Bulenta* seen were along the road mentioned. Specimens were shown of this species, also of *Problema byssus, Poanes yehl, Amblyscirtes carolina* and *Ephiphyes carolina.*

Mr. Angell spoke of his summer visits to Cook's Falls and Livingston Manor, where *Cicindela purpurea* was abundant on a steep hillside and a small red Staphylinid was found under poplar bark with ants; also of visits to Connecticut and Pine Island, N. Y.

Mr. Davis spoke of his visits to Wilmington, N. C., with Mr. Barber and the pleasant recollections that remained with him. He exhibited *Erebus odora* found August 12 at Tottenville, Staten Island, following the West Indian hurricane which he believed had blown the moth north. He spoke of three previous occurrences on Staten Island and of other northern records. Mr. Davis also described certain artificial fumaroles on Staten Island, resulting from slow combustion of material used to fill in a railroad embankment, and the effect of their warmth on insect life. The grasshopper *Dissosteira carolina* matured June 8, twelve days early, and the southern cockroach *Periplaneta americana* was enabled to survive outdoors.

Mr. Frank Johnson exhibited some remarkable Lepidoptera, including saturnid moths and a specimen of Morpho, intermediate between described forms.

Mr. Lemmer spoke of his summer visits to Lakehurst where rain had often interfered with collecting, though it had not damaged the Japanese beetle which was abundant, as were katydids. Two insects were noteworthy, *viz., Citheronia sepulchralis,* four, and *Catocala herodias,* two, all taken at light.

Mr. Swift also spoke of the Japanese beetle, its habit of going into the ground at night and its spread during the year. Mr. Bird stated that the quarantine boundary now extended to Ossining on the Hudson River and to Stamford, Conn.

Mr. Ragot exhibited the work of a caterpillar in eating linen cloth and forming its cocoon in part of its threads.

Mr. Bird described a journey to the Delaware-Maryland peninsula where box huckleberry and *Azalea atlantica* occur. *Papaipema* was sought vainly in *Helonias bullata.* At Riverhead, however, the larvæ of a noctuid moth, *Schinia* sp., was found feeding on seeds of aster.

MEETING OF NOVEMBER 16, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M., on November 16, 1926, in the American Museum of Natural His-

tory; President Frank E. Lutz in the chair, with twenty members and nine visitors present.

The Program Committee reported Dr. Campbell and Mr. Watson as speakers for meeting of December 7.

Mr. Herbert F. Schwarz gave a brief survey of some of the more salient episodes in the life history of the Bembecine wasp, *Microbembex monodonta*, as set down by other investigators, and then proceeded to give his own observations of the behavior of this insect on Fire Island. The observations were made at intervals from the middle of August to the early part of September. During this time not a single instance was noted of the stocking of the nests with prey of any kind, and the building operations were of a distinctly haphazard and apparently purposeless character. He was tempted to conclude that this represented perhaps a parallel to that noted in the case of certain other Hymenoptera, *Osmia, Megachile, Anthidium,* that persist in their tasks even when the egg-laying season has passed and their activities no longer have any significance. The fact was brought out that *Microbembex monodonta* digs a special, shallow burrow in which to spend the night even when it has available a deep commodious tunnel in the construction of which long labor has been expended.

Mr. Bird, under the title ''Synonymy,'' referred to the ''no'' of the first cave woman as a synonym of ''yes,'' to the good use of synonyms by botanists, and to his own guilty conscience, as preliminary to the synonymy of a Geometrid moth, *Sciagraphia granitata,* with eighteen synonyms, and of a Tachinid fly, *Tachina vulgaris,* redescribed and renamed 257 times. Robineau-Desvoidy established from this one species 247 so-called new species, distributed into five imaginary new genera. As an example of synonymy in ordinary conversation he told of a search for *Sanguisorba canadensis* in ''Purgatory Swamp,'' which was finally located as the ''Marsh.''

Mr. Taylor gave an interesting account of his ''Collecting Experiences in Pennsylvania,'' covering the results of several years' work near Lewistown Junction, Juniata County. A list of Lepidoptera with notes on such specimens as *Papilio ajax* and other diurnals and eleven species of *Catocala.*

Mr. R. J. Sim, present as a visitor, spoke of experiences in South Jersey, where he said anything was possible. *Lachnosterna luctuosa, æmula, diffinis, Diplotaxis frondicola,* and fifty specimens of *Onothophagus cribricollis,* previously known from single or doubtful records, were among the species seen, as Mr. Sim expressed it, ''from the tail of a naturalist's eye,'' while working on the Japanese beetle.

Mr. Davis showed Dr. Blatchley's new volume on the Heteroptera of Eastern North America, praising highly the results of his five years' study, resulting in keys and descriptions of 1,253 species.

Mr. Davis also showed portrait of Mrs. Slosson to accompany the obituary notice in the JOURNAL and spoke of her varied activities, authorship of twelve books, which in part have already become famous the world over,

china collecting, etc., besides her entomological work in Florida and the White Mountains, resulting in over 100 species and several genera being named in her honor.

He also showed communications from R. J. Hunter and Charles Drury, the latter 79 years old and still finding rare beetles in his garden, where a pile of decaying grass serves as bait.

Mr. Melander contributed to the program, colored drawings of leaf-hoppers from his correspondent, Schild at La Suisa, Costa Rica.

Mr. Lemmer exhibited a box of splendidly prepared moths from Lakehurst, N. J., a part of the result of this year's collecting and each a rarity. The species were as follows: ♂ *Lapara coniferarum,* Wlbe., ♂ *Citheronia sepulchralis,* G. & R., ♂ *Apantesis figurata* Dru., ♂ *Apantesis figurata* form *excelsa* Neum., ♂ & ♀ *Pygarctia abdominalis* Grt., ♂ & ♀ *Graptolitha viridipallens* Grt., ♀ *Graptolitha querquera* Grt., ♀ *Graptolitha nigrescens* Engel., ♂ & ♀ *Graptolitha lepida* Lint., ♂ & ♀ *Graptolitha thaxteri* Grt., ♂ & ♀ *Epiglaea apiata* Grt., ♂ & ♀ *Psectraglaea carnosa* Grt., ♀ *Acronycta wanda* Buchh., ♂ & ♀ *Acronycta lanceolaria* Grt., ♂ & ♀ *Papaipema stenoscelis* Dyar., ♂ & ♀ *Catocala andromedæ* Gn., ♂ & ♀ *Catocala herodias* Stkr., ♂ *Caripeta angustiorata* Wlk., ♂ *Nacophora ypsilon* Forbes, ♂ & ♀ *Stenaspilates zalissaria* Wlk.

MEETING OF DECEMBER 7, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M., on December 7, 1926, in the American Museum of Natural History; President Frank E. Lutz in the chair, with twenty-four members and nine visitors present.

Dr. Bertha Chapman Cady, 670 Lexington Avenue, New York City, was elected a member of the Society.

Dr. Lutz exhibited for Dr. Mikinosuke Miyajima, of Tokyo, Japan, drawings illustrating his discovery, thus first announced in America, of the control by the firefly, *Luciola picticollis,* of a disease prevalent in Japan. The disease is due to a parasitic worm working in the liver and spleen. The worm being discharged in the fæces, passes its next stage in an amphibious snail. The luminous larva of the firefly attacks the snail, and thus checks the spread of the parasite and the disease it causes.

Dr. Frank L. Campbell read a paper on the "Chemical and Physical Properties of Chitin," reviewing the work of Odier in 1821 and the more recent discussions. He gave as its formula, $C_{32}H_{54}N_4O_{21}$ and as its strongest characteristic, insolubility in alkali. He pointed out that it constituted little more than one fourth the exoskeleton of beetles, and that therefore some of the properties apparently belonging to it and commonly expressed as "heavily chitonized" were due in part to other substances. It appeared to be the same, regardless of its source, and has been identified in such widely separated organisms as Crustacea and mushrooms. He promised

at a future meeting to show the reaction to sulphuric acid and iodine by which its presence is detected.

The paper was discussed by Dr. Lutz, Mr. Weiss, Dr. Stanton, present as a visitor, and by Mr. Johnson, whose question as to the substitution of nitric acid for muriatic acid, in the softening of chitinized material, brought out the relation of chitin to cellulose rather than protein, and the danger of unintentionally making an explosive compound.

Mr. Watson exhibited two boxes containing twenty gorgeous South American butterflies, Morphos, etc., a part of a recent gift from Mr. Frank Johnson to the American Museum of Natural History.

Dr. E. A. Chapin, of the U. S. National Museum, spoke of the work in progress there on the Casey collection. Mrs. Casey has provided the cases and the salary of a curator, Mr. Buchanan, who, in two or three years time, will have the whole collection, 75,000 to 125,000 specimens, so transferred that every specimen, from 5,000 to 6,000 of which are types, can be recognized as in the order in which Col. Casey left them, and will always be retained in the separate species trays used in the National Museum. Mrs. Casey has also provided a binocular microscope to aid students, to whom every facility for study will be extended but only in the room in which the collection is housed.

Dr. Chapin spoke with regret of the feebleness of Dr. Schwarz who was retired August 1, 1926, aged 82, after nearly fifty years of service; and of his own studies in Cleridæ, leading to the opinion expressed in his work on Philippine clerids that the Korynetinæ should be treated as a subfamily. He also, at the president's request, gave a brief account of the life history of these predaceous insects and their value in checking depredations of forest insects.

Mr. Leng recalled the origin of the name *Necrobia.*

Dr. Cady spoke of the nature study program of the Girl Scouts and exhibited some excellent drawings made by members of her troop. For those who showed the greatest interest, problems in botany and entomology were suggested. Dr. Cady also spoke of the advantage of coordination of the work of different organizations devoted to nature study.

Dr. Lutz, in commenting on Dr. Cady's remarks, spoke of the work accomplished at the Field Station by Mr. Steele and Mr. Creighton, who had been the guests of Mr. Frank Johnson, as an example of such coordination. He also announced the Philadelphia A. A. A. S. meeting at Philadelphia, December 27–31.

Mr. Davis exhibited Essig's "Insects of Western North America."

MEETING OF DECEMBER 21, 1926

A regular meeting of the New York Entomological Society was held at 8 P. M., on December 21, 1926; Dr. Frank E. Lutz, President, in the chair, with twenty members and four visitors present.

The program committee reported Messrs. Notman and Nicolay as the speakers for the next meeting.

The president appointed as a nominating committee, Messrs. Barber, Weiss, and Mutchler.

Dr. William Rudolfs read a paper on ''Some of the Results Obtained in a Study of the Chemical Changes During the Life Cycle of the Tent Caterpillar,'' which will be printed in full. It was discussed by Dr. Lutz and Dr. Campbell. The surprising fact disclosed by his analyses was an increase in percentage of fat in the prepupal stage accompanied by a rapid decrease in that stage of the nitrogen percentage.

Dr. Rudolfs also exhibited *Achorutes viaticus,* a springtail found in the filter bed of a sewage disposal plant at Madison, Wis., which, by keeping the stones in the bed clean, saves about $2,000 a year in cost of upkeep.

Mr. Leng gave some ''Remarks on the Forthcoming Supplement to the Catalogue of Beetles,'' pointing out the rapid increase in the number of names, in the use of trinomial and quadrinomial names, and the numerous changes in nomenclature caused by strict application of its rules.

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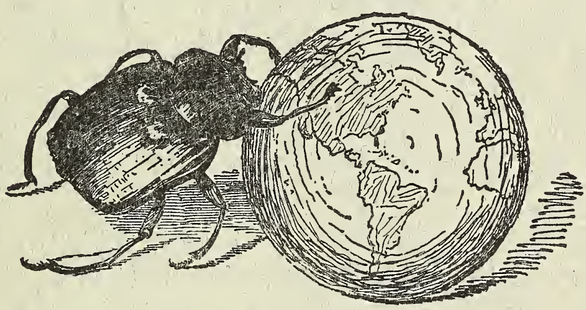

DECEMBER, 1927

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JOURNAL

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Vol. XXXV December, 1927 No. 4

THE NORTH AMERICAN SPECIES OF THE GENUS POTAMANTHUS, WITH A DESCRIPTION OF A NEW SPECIES

By Virgil N. Argo

The material on which this study is based is part of the Cornell University collection and comes from Iowa, Michigan, Pennsylvania, New York, Maryland, and Tennessee. During the summer of 1926 the writer had the opportunity of making fairly regular collections in the Potomac River and some of its tributary streams in the state of Maryland and was fortunate in collecting at least three species of *Potamanthus* in the adult stage and a large number of unidentified nymphs belonging to the same genus. The members of the genus have been somewhat confused and this paper is an effort to clear up some of the taxonomic difficulties in the group. In the past there have been six species described from North America: *P. verticis* Say, originally classed as a *Baetis,* then put in *Ecdyurus* by Eaton, listed in Bank's catalogue under *Heptagenia,* and finally placed in *Potamanthus* by McDunnough in 1926; *P. flaveola* Walsh, originally described as an *Ephemera,* and listed in Bank's catalogue as a *Potamanthus; P. myops* Walsh, originally described as an *Ephemera* and put into *Potamanthus* by McDunnough in 1926; *P. medius* Banks, originally described as a *Potamanthus; P. diaphanus* Needham and *P. inequalis* Needham, originally described as species in *Potamanthus.*

The descriptions are scattered in the literature and as a whole are rather incomplete and unsatisfactory. There has been a lack of uniformity in the manner of handling and describing material; some has been used in the fresh condition; some has been pinned and dried and some has been preserved in alcohol and with forms so delicate and so lightly colored this would naturally lead to ambiguity. In the Cornell Collection all material is kept in alcohol and as specimens are studied the wings are mounted on one slide and the head, legs, genitalia and tails are mounted on another slide. If there are distinctive patterns on the abdomen or thorax these parts are cleared and mounted also.

In going over the material in the Cornell Collection there seem to be at least five distinct species represented; *verticis, flaveola, myops, diaphanus,* and one which will be described in this article. They fall into two groups, those in which the males have small eyes separated by a distance of more than two eye diameters, and those in which the males have large eyes, separated by a distance of but little more than one eye diameter. In the first group would be placed *verticis, myops,* and the one new species, while in the second group would be placed *flaveola* and *diaphanus.* The comparative size and position of the eyes is a character which has been used but once in the past, by Walsh in separating *myops,* a small-eyed species, from *flaveola,* a large-eyed species. No mention of the kind of eyes found in *verticis* is made by Say. According to his very incomplete description, the infuscated cross veins and the small size are its only distinguishing characters. In separating *verticis* from *flaveola* I took all the male specimens which showed black on the cross veins to any degree and found that they were uniformly smaller than *flaveola* and that they all had small and widely separated eyes. Since the males of *flaveola* do not have infuscated cross veins, according to Walsh's description, I have called these specimens *verticis,* and would add to Say's description the matter of the eye dimension as a very easily observed character.

Needham's type specimen of *inequalis* seems to have been lost and as a result it has not been treated in this grouping. It was separated from *diaphanus* through an apparent difference in the outline of the penes of the male, but after making careful exami-

nation of all the material at hand, it appears that there are no specific differences in the shape of the male genitalia of the species in the genus and any variation in outline might be due to differences of turgidity and muscular contraction. There is a fairly constant size variation within the genus, and in one species there is a color character associated with the genitalia, but for the lack of other characters *inequalis* should be classed as a synonym of *diaphanus*.

Banks' *medius* was described from females and the female differences have not been studied sufficiently to tell whether his species is valid or not. I have been unable to separate it on the characters he gives.

In the past the distinction between the nymphs of *Potamanthus* and *Polymitarcys* has been held to consist only of this one difference; in *Potamanthus* the tusk-like ramus on the side of the mandible is short and barely extends beyond the labrum, while in *Polymitarcys* the tusk is long and extends some distance beyond the edge of the labrum. This distinction was apparently substantiated by a single adult *Polymitarcys* which was said to have been reared from one of the long-tusked nymphs by W. E. Howard in 1904. This past summer Doctor Needham collected from the Jordan River in Utah, and the writer collected from the Potomac River in Maryland, a series of nymphs which are entirely different and resemble nothing previously collected in this country. They correspond exactly with Eaton's description of the nymph for the genus *Polymitarcys,* resembling very closely his figure of *P. virgo,* the type of the genus. An examination showed the developing wing pads to have the typical *Polymitarcys* wing venation. An examination of the wing pads of nymphs which had previously been held to be *Polymitarcys* in this country, showed that they had typical *Potamanthus* wing venation. Thus it is found that the nymphs of *Potamanthus* are entirely different from those of *Polymitarcys* and have an entirely different mode of living. The former are found on the sand and gravel at the edge of riffles where the water is not too swift, while the latter are burrowing forms which are dug up out of the sand and silt where the water is flowing slowly and the bottom is soft. They have elaborate strainers of parallel bristles

on the mouth parts and the fore legs, which would seem to act as sieves for getting the available food from the ooze and silt of the bottom. An examination of the original nymphal skin from which Howard claimed to have reared a specimen of *Polymitarcys albus* shows it to have been a *Potamanthus* nymph, some faulty observation having been made to give rise to this error which has persisted so long. The length of the mandibular tusk of the *Potamanthus* nymph seems to vary with species. Among the nymphs in the Cornell Collection there are some with very short tusks and some with long tusks, but as far as I know there are no specimens with tusks as short as Eaton has shown in his figure for the nymph of *P. luteus*.

KEY TO THE NORTH AMERICAN SPECIES OF POTAMANTHUS

1. Eyes of the male small, separated by a distance equal to at least twice the eye diameter........ 2
   Eyes of the male large, separated by a distance equal to little more than one eye diameter........ 4
2. Species with a wing expanse of over 20 mm.; no infuscation on veins or cross veins of male or female........ 3
   Species with wing expense of less than 20 mm.; cross veins infuscated on male and female; vertex, thorax, and the tip of anterior femur, ferruginous; vittae on sides of abdomen, tip of anterior tibia, incisures of anterior tarsus, and incisures of tails, fuscous........*P. verticis*.
3. Species yellowish white; wing expanse of male 28–29 mm.; fore leg 9 mm.; body 15 mm.; tails 30–20–30 mm.; vertex, antennae, tip of anterior femur, tip of anterior tibia, incisures of tails, and incisures of genital forceps, ferruginous; vittae on sides of abdomen and tarsal incisures, fuscous ....*P. rufous* n. sp.
   Species white; expanse of male 26–27 mm.; fore leg 11 mm.; body 12–13 mm.; tails 28–20–28 mm.; tip of anterior tibia, incisures of anterior tarsus, incisures of tails, slightly ferruginous; no fuscous vittae on sides of abdomen and no coloring of the incisures of the genital forceps ....*P. myops*.
4. Wings an expanse of 18–22 mm.; male with no infuscation on cross veins, female with cross veins infuscated; vertex, thorax, and tip of anterior femur, ferruginous; tip of anterior tibia, incisures of anterior tarsus, incisures of tails, and vittae on sides of abdominal segments, fuscous ....*P. flaveola*.
   Wing expanse 20 mm.; neither male or female has infuscated cross veins; vertex, thorax, pale yellowish white; tip of anterior tibia and incisures of anterior tarsus faintly infuscated; tails white with colorless incisures ....*P. diaphanus*.

Potamanthus rufous new species.

Wing expanse of male 28–29 mm.; bod y15 mm.; tails 30–20–30 mm.; fore leg of male 10 mm.; eyes small, separated by a distance equal to 2½ times the eye diameter; vertex, antennae, and thorax, ferruginous; abdomen yellowish with with fuscous spots on sides of segments; incisures of tails strongly ferruginous; tips of anterior femora and tibae, strongly ferruginous; incisures of anterior tarsi fuscous; incisures of genital forceps ferruginous; wings hyaline with no color on veins or cross veins.

Females: wing expanse 33 mm.; body 16 mm.; tails 20 mm., middle one but little shorter than the other two; fore leg 9 mm.; eyes small, separated by a distance equal to three times the eye diameter; antennae, vertex, and thorax, ferruginous; abdomen white with fuscous dots on sides of segments; incisures of tails strongly ferruginous; anterior femora and tibiae strongly ferruginous their entire length; incisures of anterior tarsi fuscous.

The female is more strongly ferruginous than the male, slightly larger in expanse of wing and length of body, and has the eyes more widely separated. It cannot be confused with the *P. medius* described by Banks.

Described from two males and one female taken at Corning, N. Y., July 8, 1924, by C. R. Crosby, and one male taken at McLean Reservation, Tompkins Co., N. Y., July 12, 1924.

This species is the largest one in the genus and seems to be a distinct form. It is most easily recognized by its large size and the amount of reddish coloring found on the body; it is the only one examined which showed any color at the incisures of the genital forceps. The body and genitalia are found to be regularly larger than is the case in *myops*, while the front leg of the male is considerably shorter than that of *myops*. The fuscous dots on the sides of the abdomen are plainly seen, but Walsh after examining a series of specimens of *myops* made no mention of any such spots.

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BANKS, NATHAN. Catalogue of the Neuropteroid insects (except Odonata) of the United States. Philadelphia, 1907.

In his catalogue Banks lists but one species in the genus Potamanthus, *P. flaveola* Walsh.

BANKS, NATHAN. Neuropteroid insects—notes and descriptions. Trans. Am. Ent. Soc., XXXIV, 1908, p. 259.

Banks describes the species *P. medius* from female specimen collected at electric light in July from Douglas Co., Kansas.

EATON, REV. A. E. A revisional monograph of recent ephemeridae or mayflies. Trans. Linn. Soc. of London, Second series, Vol. III, Zoology, 1888.

Eaton describes the genus, restricting it much more than Pictet had done and designates *P. luteus* Linn. as the type. He gives complete descriptions of adult and nymph of *luteus*. But he seems to have had something different from what Say had when he describes *verticis*, which he places in *Ecdyurus*, the color characters which he gives are very clearly different from what Say gave to *verticis*.

HOWARD, W. E. Mayflies and midges of New York, by James G. Needham, N. Y. State Mus. Bul. 86, Ent. 23, 1905.

Needham includes an account by Howard in which he describes a nymph from which he claims to have reared an adult *Polymitarcys albus* Say. I have examined the nymphal skin and find it to be that of a long-tusked Potamanthus species.

McDUNNOUGH, J. Note on North American Ephemeroptera with discriptions of new species. Can. Ent., Vol. LVIII, no. 8, 1926.

McDunnough claims that *flaveola* is a synonym of *verticis*.

MORGAN, ANNA H. Mayflies of Fall Creek. Ann. Ent. Soc. of America, Vol. IV, 1911, pp. 93–119.

Mention is made of a half grown nymph of *Potamanthus* which was observed in Fall Creek, near Ithaca, N. Y. It is described as having short tusks on the mandibles. No name is given to it.

MORGAN, ANNA H. A contribution to the biology of mayflies. Ann. Ent. Soc. of America, Vol. VI, 1913, pp. 371–413.

In this paper Miss Morgan describes the life habits of the nymphs of Potamanthus and Polymitarcys but they should both be in the genus Potamanthus. She figures a *Potamanthus* nymph, and the mandibular tusks are seen to be somewhat longer than the ones shown in Eaton's figure of *P. luteus*.

NEEDHAM, JAMES G. Burrowing mayflies of our larger lakes and streams. Bul. of the Bur. of Fisheries, Vol. XXXVI, 1917–18, pp. 269–292.

In this paper Dr. Needham describes the nymphs of *Potamanthus* and *Polymitarcys*, but the form he has figured as *Polymitarcys* is the long-tusked species of *Potamanthus*.

PICTET, F. J. Histoire naturelle des insectes neuroptères, 1843, Vol. II, p. 197.

Pictet describes the genus *Potamanthus* for the first time and groups a number of new and old species under it but describes no type for the genus.

SAY, THOMAS. Descriptions of new North American Neuropterous insects, and observations on some already described. Acad. Nat. Sci. of Phil., Vol. VIII, 1839, pp. 9–46.

Say describes *verticis* under the genus *Baetis*.

WALSH, BENJ. D. List of the Pseudoneuroptera of Illinois, contained in

the cabinet of the writer, with descriptions of over forty new species. Proc. Acad. Nat. Sci. of Phil., Vol. XIV, 1862, p. 377.

Walsh describes *flaveola* under the genus *Ephemera.*

WALSH, BENJ. D. Observations on certain North American Neuroptera, by H. Hagen, M.D., of Königsburg, Prussia; translated from the original French MS., and published by permission of the author, with notes and descriptions of about twenty new North American species of Pseudoneuroptera. Proc. Ent. Soc. of Phil., Vol. II, 1863–4, p. 207.

Walsh describes *myops* in this paper, and makes use of the comparative size of the eyes in differentiating it from *flaveola.*

PLATE XIV. ADULT STRUCTURES

FIG. 1. Head of *Potamanthus verticis* Say, male, collected near Hagerstown, Md.

FIG. 2. Genitalia of same.

FIG. 3. Wing of same, shows infuscation of crossveins.

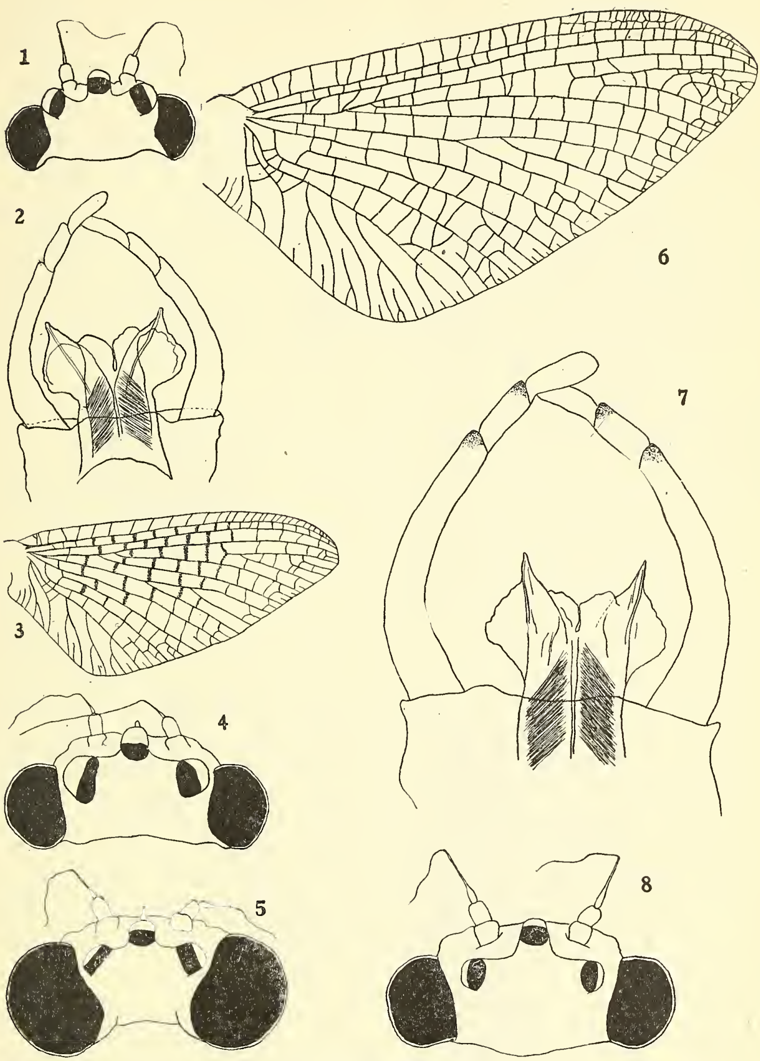
FIG. 4. Head of *Potamanthus myops* Walsh, collected near Hagerstown, Md.

FIG. 5. Head of *Potamanthus flaveola* Walsh, collected near Hagerstown, Md.

FIG. 6. Wing of *Potamanthus rufous* n. sp., collected at Corning, N. Y.

FIG. 7. Genitalia of same, shows ferruginous incisures of forceps.

FIG. 8. Head of same.



POTAMANTHUS

PLATE XV. NYMPHAL STRUCTURES

FIG. 9. Nymph of *Polymitarcys virgo* Ol. Figure copied from Eaton.

FIG. 10. Head of nymph of *Polymitarcys* sp. collected in the Potomac River, Md.

FIG. 11. Under surface of right mandible of same.

FIG. 12. Upper surface of left mandible of same.

FIG. 13. Gill of same.

FIG. 14. Gill of *Polymitarcys virgo* Ol. Figure copied from Eaton.

FIG. 15. Fore leg of *Polymitarcys* sp. collected in the Potomac River, Md. It shows the elaborate development of bristles into strainers on the tibiae.

FIG. 16. Middle leg of same.

FIG. 17. Hind leg of same.

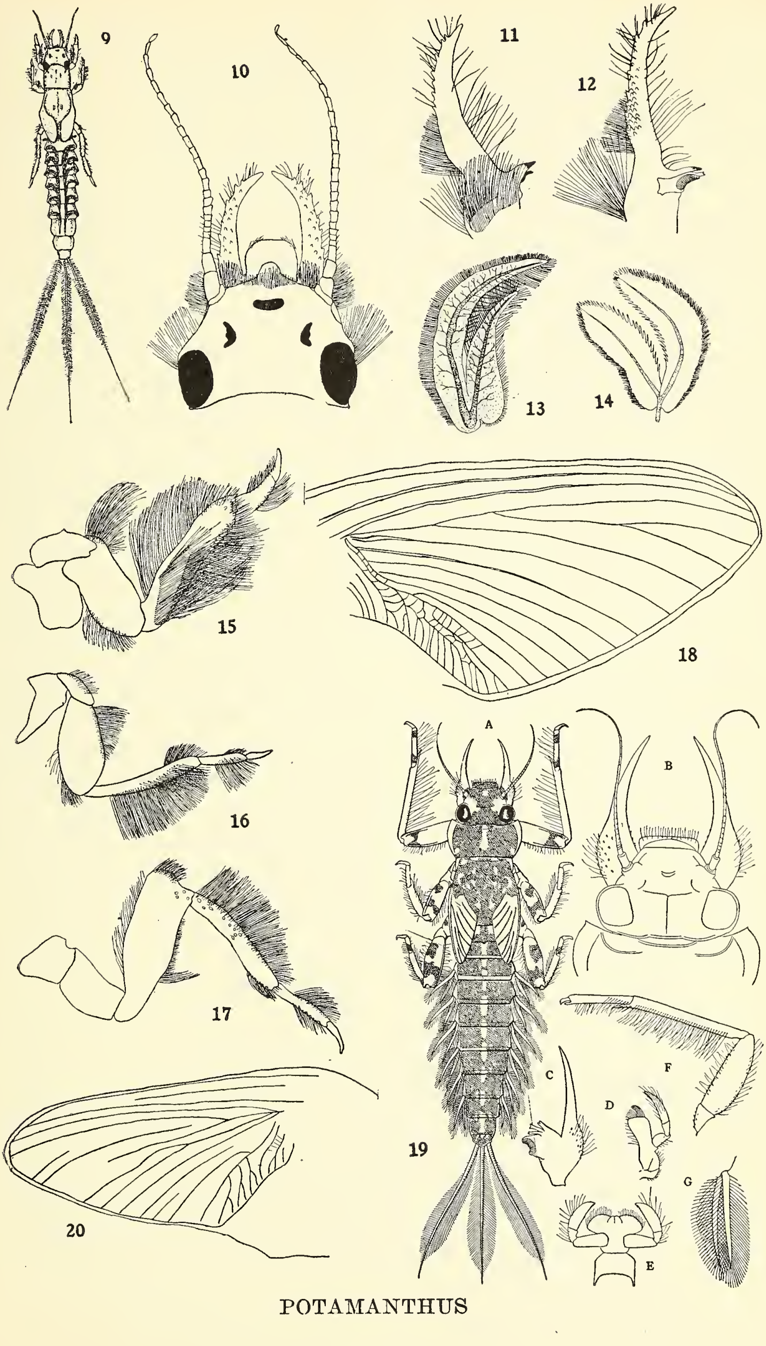
FIG. 18. Wing pad from same. Shows typical *Polymitarcys* venation.

FIG. 19. Plate taken from Needham's paper, "Burrowing Mayflies of our Larger Lakes and Streams." Drawings by C. H. Kennedy.

a. Nymph from above.
b. Head of same enlarged.
c. Mandible of same.
d. Maxilla of same.
e. Labium of same.
f. Fore leg of same.
g. Gill of the second abdominal segment.

These drawings were made from the nymphal skin from which Howard said he reared an adult *Polymitarcys albus* Say, it is a typical *Potamanthus* and differs from Eaton's figure of the nymph of *Potamanthus luteus* Linn. only in the comparative length of the mandibular tusks.

FIG. 20. Wing pad nymph of *Potamanthus* sp., collected in Potomac River, Md. This nymph seemed to be identical with the one figured above, and the wing pads showed the typical *Potamanthus* venation.



POTAMANTHUS

STUDIES ON THE SILPHINÆ[1]

BY MELVILLE H. HATCH

The purpose of the present study is (1) to discuss the genera of living and fossil Silphinæ, (2) to construct a synoptic table to the described larvæ, (3) to consider the North American species of Silphinæ, (4) to delimit more precisely their ranges,[2] (5) to consider their relationship with the extra-Nearctic species, (6) to consider the natural groupings and interrelationships of the species of *Nicrophorus*,[3] (7) to make known the contents of an extensive collection of *Nicrophorus* secured by the author from Mr. John W. Angell, of New York City, in 1922, and (8) to review the known fossil Silphinæ.

Types, unless otherwise indicated, are in the collection of the author. Concomitantly with the present studies, the author has been engaged in the preparation of the portion on Silphidæ, exclusive of Bathysciinæ, for the Junk-Schenkling *Coleopterorum Catalogus* (Pars 95), and must refer the reader there for bibliography. Furthermore, in an investigation published in connection with a paper entitled "Studies on the Carrion Beetles of Minnesota, Including New Species" (Univ. Minn. Agr. Exp. Sta. Tec. Bull. 48, 1927, 19 pp.), the author has delimited the Silphinæ as a subfamily of Staphylinidæ.

Acknowledgments are due Mr. John W. Angell for favors too numerous to mention; Mr. J. B. Wallis for information on the composition of the Manitoba fauna; Mr. F. S. Carr for similar

---

[1] Contribution from the Department of Zoölogy of the University of Minnesota.

[2] M. Gaston Portevin in his most excellent work on *Les Grands Nécrophages du Globe*, (270 pp., 201 fig., Ency. Ent. VI, 1926, Paris), too frequently uses the expression "toute l'Amérique du Nord" in describing the range of species. There is not a single species of the group whose range even approximately conforms to this description!

[3] This is the original spelling of the genus, and the one adopted in all systematic works between the date of its description in 1875 and its change to *Necrophorus* in the *Systema Eleutharum* of Fabricius in 1801.

information on the fauna of Alberta; Prof. E. O. Essig for larvæ of *Silpha ramosa* Say; Prof. R. A. Cooley for larvæ of *Silpha bituberosa* Lec.; Miss Helen R. Parker for assistance in preparing the plate; Dr. Walther Horn of the Deutsche Entomologische Institut for the loan of specimens of *Apatetica, Ecanus,* and other material.

I. GENERAL CLASSIFICATION

In order to outline the general interrelationships of the Silphinæ, the following keys to imagoes and larvæ are presented. In these, as in the other keys of the present study, an attempt is made to indicate relationships as well as to furnish a means for identification. In the key to the imagoes of the Lyrosomini[4] and Agyrtini all the genera known are included. The key to larvæ includes all the genera of which the larvæ have been adequately described, though I know of *Necrophilus, Xylodrepa, Phosphuga,* and *Ablattaria* from descriptions only. In addition to descriptions and figures I am indebted to the following keys of silphine larvæ: Henriksen, Danm. Faun. Bill. V, 1922, pp. 252–260; Ganglbauer, Käf. Mitteleur. III, 1899, p. 168; Karsh, Ent. Nachr. X, 1884, p. 226; Reitter, Naturg. Ins. Deut. III (2), 1885, p. 284.

KEY TO IMAGOES

A^1. Elytra nine-striate, rarely with the striæ becoming obsolescent and the elytra becoming transversely strigose.

B^1. Antennæ filiform; abdomen with 6 visible sternites. **LYROSOMINI.**

C^1. Elytra entire.

D^1. Posterior coxae contiguous.

E^1. Body elongate, subdepressed.

F^1. Tibia feebly spined without; penultimate tarsomere simple; tarsi slender; Asia, Pacific Coast of North America, Mexico; (type *Necrophilus tenuicornis* Lec.) ....**Apteroloma** Hatch

F^2. Tibia strongly spined without; penultimate tarsomere bilobed; tarsi short; Japan, Yunnan. **Brachyloma** Port.

[4] Through the removal of *Pteroloma forstroemi* Fröl., from Silphinæ, Lyrosomini Horn 1880 must replace Pterolomini as the name of the first tribe of the subfamily.

E2. Body subhemispherical; penultimate tarsomere bilobed; Himalayas .... **Sphaeroloma** Port.*

D2. Posterior coxæ separated; 6th abdominal sternite only slightly visible; Japan to Alaska............ **Lyrosoma** Mann.

C2. Elytra truncate; Oriental .... **Apatetica** Hope.

B2. Antennæ gradually clavate.

C1. Pronotum wider than long.

D1. Posterior coxæ separated; abdomen with 6 visible sternites; elytra at base with minute strially arranged punctures, at apex smooth; Nearctic.

CATOPOCERINI, Catopocerus Mots.†

D2. Posterior coxæ contiguous; abdomen with 5 visible sternites in ♀, 6 in ♂ .... **AGYRTINI.**

E1. Pronotum as wide as elytra; body subdepressed.

F1. Elytra not transversely strigose, distinctly striate.

G1. Elytra entire.

H1. Ultimate segment of antenna no longer than penultimate; terminal segment of palpus thickened, twice as long as the next; antennæ feebly clavate; mesosternum simply carinate in front; body more elongate; pronotum widest at base, smaller in proportion to elytra and less transverse than in the succeeding genera; Palaearctic and Pacific Coast of North America, (one species from Upper Miocene of Florissant, Colo.).

Agyrtes Fröl.

H2. Ultimate segment of antenna longer than penultimate; terminal segment of palpus cylindrical, 1½ times as long as the penultimate segment; body and pronotum more transverse.

I1. Antennæ feebly clavate; mesosternum simply carinate in front.

J1. Pronotum with distinct but rounded hind angles, widest at base, sides deplanate; Japan to

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* I place in this genus, though somewhat tentatively, *castaneicolor* and *gibbus* Champion (Ent. Mo. Mag. LIX, 1923, p. 48) described from the Himalayas as *Necrophilus* subg. *Necrophiloides* nov., and separated from the true *Necrophilus* by their nearly filiform antennae and extremely convex body.

† = *Pinodytes* Horn, Portevin, Misc. Ent. XXVI, 1923, p. 2.

Alaska, Washington and Alberta ....**Pelatines** Cock.

J². Pronotum without hind angles, broadly rounded, widest before base, sides not deplante; Germany to Siberia. **Ecanus** Steph.

I². Antennæ strongly clavate with a strongly differentiated club which is evidently pubescent, the basal 6 segments glabrous; mesosternum with a low carina in front of which is an elevated area furrowed throughout its entire length; pronotum at base; Holarctic, ? New Zealand ....**Necrophilus** Latr.

G². Elytra abbreviated, truncate.

H¹. Antennæ feebly clavate; last three segments of abdomen exposed; antennæ apparently 10-segmented (perhaps 11-segmented), feebly dilated towards apex; elytra with eight visible striæ; Upper Miocene of Florissant, Colo. **Miosilpha** Wick.

H². Antennæ with wide club of 5-segments; Japan, India................**Nodynus** Waterh.

F². Elytra transversely strigose.

G¹. Mesosternum carinate in front; pubescent; striæ except sutural reduced.

H¹. Scarcely striate; Chile....**Agyrtodes** Port.

H². Not striate; New Zealand. **Ragytes** Port.*

G². Mesosternum simple in front.

H¹. ♂ with mesotarsi simple and last abdominal sternite entire; Chile. **Dasypelates** Port.

H². ♂ with mesotarsi dilated and last abdominal sternite excavated; Chili. **Eupelates** Port.

E². Pronotum narrower than elytra; body oval, almost hemispherical; Greece, Syria ....**Ipelates** Reitt.

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* Portevin (Ann. Soc. ent. Belg. LVIII, 1914, p. 197) suspects that *Catopsolius* Sharp, *Inocatops* Broun, and *Asaphaerites* Broun, all from New Zealand, may be Agyrtini, but Jeannel (Arch. Zool. exp. gen. LXI, 1922, p. 40) regards them as Camiarinae (Catopidae).

C2. Pronotum longer than wide, strongly convex, strongly emarginate in front and sinuate at sides, finely margined throughout; 4–5 mm. long; Madagascar, Natal.
EUSTADIINI, Eustadia Fairm.

A2. Elytra tricostate or less....**SILPHINI, NECRODINI, NICROPHORINI.**

KEY TO LARVÆ

A1. Ocelli 6 on each side, rarely 5.

B1. Hind angles of thoracic tergites not produced.

C1. Campodeiform.

D1. Prothorax very little narrower than mesothorax; dorsal plates without paler side margins, side margins not appreciably expanded; second abdominal sternite undivided.

E1. Caudal margin of abdominal tergites immediately mesad of hind angles with two to three bristle bearing tubercles or dentiform processes.
Necrophilus Latr.

F1. Necrobious and saprobious.
hydrophiloides Mann.

F2. Geobious ....**subterraneus** Dahl.

E2. Caudal margin of abdominal tergites without processes; necrobious..............Subg. **Thanatophilus** Sam.

F1. Pronotum without side margin, feebly rounded; 2nd antennal segment with a small preapical knob below; 18 mm. long.
rugosa L., **dispar** Hbst.

F2. Pronotum with side margins.

G1. Second antennal segment with small preapical knob. ....**lapponica** Hbst.

G2. Second antennal segment without knob; side margins of pronotum not rounded; 16 mm. long ....**sinuata** F.

D2. Pronotum somewhat narrower than mesonotum; dorsal plates with feebly expanded and paler side margins; second abdominal sternite divided into three parts; necrobious......**Necrodes littoralis** L. and **surinamensis** F.

C2. Blattiform; pronotum produced in front with oblique and somewhat sinuate side margins; dorsal tergites moderately expanded at sides and paler....................**Diamesus osculans** Vig.

B2. Blattiform; hind angles of thoracic tergites produced; margin of dorsal plates expanded; second abdominal sternite a single piece.

C1. Pronotum nearly as long as wide with a deep transverse groove behind its front margin; margins of dorsal tergites not paler; only 5 ocelli; on trees.
(**Xylodrepa** Thoms.) **quadrimaculata** Sch.

C2. Pronotum transverse.

D1. Pronotum not covering head.

E1. Pronotum strongly emarginate in front; margins of dorsal tergites strongly expanded, paler; necrobious. (**Oiceoptoma** Sam.) **thoracica** L., **noveboracensis** Forst., **inaequalis** F.

E2. Pronotum feebly emarginate to arcuate.

F1. Antennæ not extending beyond pronotum.

G1. Pronotum feebly emarginate (not emarginate in first and second instars of *bituberosa*); margins of dorsal tergites narrowly expanded.

H1. Dorsal plates with pale side margins; phytophagous........(**Blitophaga** Reitt.)

I1. Dorsal plates glabrous (?) **opaca** L.

I2. Dorsal plates with short hairs. **bituberosa** Lec.

H2. Dorsal plates with black side margins.

I1. Pronotum emarginate in front as in *Blitophaga*. (**Heterosilpha** Port.) **ramosa** Say.

I1. Pronotum more strongly rounded in front; phytophagous. (**Aclypea** Reitt.) **undata** Müll.

G2. Pronotum distinctly arcuate in front; margins of dorsal plates moderately expanded, not paler; necrobious. (**Necrophila** Kly.) **americana** L.

F2. Antennæ extending beyond mesonotum, the third segment elongate (**Ablattaria** Reitt.) **laevigata** F. (**Phosphuga** Leach) **atrata** L.

D2. Pronotum nearly or completely covering head, strongly arcuate in front; margins of dorsal tergites strongly expanded; necrobious................................(**Silpha** (s. str.))

E1. Head not completely covered by pronotum.

F1. Third antennal segment longer than second; tergites shining, finely pubescent; side processes of tergites tri-colored, pale behind; base of pronotum covered by metanotum; 22 mm. long. **tristis** Ill.

F2. Third antennal segment no longer than second; tergites opaque, densely pubescent; side processes of tergites unicolored; 20 mm. long. **carinata** Hbst.

E2. Hind portion of head completely covered by pronotum; third antennal segment no longer than second; tergites dull, densely pubescent, side processes tricolored, pale behind; base of pronotum not covered by metanotum; 18 mm. long........**obscura** L.

A2. Ocelli 2 on each side; eruciform; abdominal tergites small, with four spines at base; necrobious; sternites absent................**Nicrophorus** F.

B1. Ninth tergite without lateral teeth; cerci short, not reaching beyond ninth segment; mandibles without teeth at apex; third segment of palpi not longer than second; color yellowish; 27 mm. long ....**vespillo** L.

B2. Ninth tergite with lateral teeth; cerci longer, extending beyond ninth segment; mandibles with 6 or 7 evident teeth; color whitish.

C1. Basal segment of cerci firmly united with ninth tergite without an intervening suture; third segment of palpus 1/3 longer than second; 23 mm. long.............................**vespilloides** Hbst.

C1. Basal segment of cerci with evident suture separating it from ninth tergite; third segment of palpus as long as second.

D1. First segment of cerci 4 times as long as broad, width about 1/6 that of tergite; 27 mm. long.
investigator Zett.

D2. First segment of cerci twice as long as broad; width about 1/8 that of tergite; length 33 mm.............**humator** Oliv.

The suggestion is put forth that the groups with nine-striated entire elytra, cordate pronotum, filiform antennæ, and a campodeiform larva with bisegmented cerci and without lateral expansions on the dorsal plates represent the primitive condition of the subfamily.

Larvæ.—Though the campodeiform larva of *Necrophilus subterraneus* is the only lyrosomin or agyrtin larva known, it is probably safe to assume that the general larval type of these tribes is campodeiform, and the same type of larva is found in *Thanatophilus.* The larval types of the higher Silphinæ exhibit three lines of modification: (1) The necrodin larva in which the lateral margins of the tergites are moderately expanded, but without the posterior angles of the thoracic tergites being produced. In *Necrodes* the larvæ are campodeiform; in *Diamesus* they are so broad as to warrant the designation blattiform. (2) The eruciform, fleshy larva of *Nicrophorus* with feeble powers of locomotion, and that spends its life in the carcass where the eggs have been laid by the parent. (3) The flattened blattiform

larvæ of the *Blitophaga-Necrobora-Oliceoptoma-Silpha* series in which the side margins of the tergites become more and more expanded, the posterior angles of the thoracic tergites become produced, and the pronotum eventually comes to cover the head completely.

Elytra.—The tricostate elytra has, perhaps, been derived from the 9-striated one by the elevation of alternate elytral intervals, as exhibited in *Necrophilus pettitii* Horn.

Pronotum.—Four types of pronotum are exhibited by the Silphinæ. (1) The cordate type in which the basal portion is constricted so that it is narrower than the base of the elytra, the hind angles distinct, and the margins just anterior to the hind angles sinuate. This type occurs in *Lyrosoma,* in certain species of *Apteroloma,* and elsewhere, and is regarded as the primitive type. (2) The silphoid type, narrowed anteriorly with the hind angles not distinct, exemplified by certain species of *Apteroloma, Necrophilus, Silpha,* and *Diamesus.* (3) The orbicular type of *Necrodes* and certain groups of *Nicrophorus.* (4) The posteriorly narrowed type, but absolutely without evidence of hind angles, in the remaining species of *Nicrophorus,* in *Ptomaphagus,* and the fossil *Palaeosilpha.* The first type is found only in the 9-striated genera. The second type is found in both 9-striated and tricostate genera. The third type is found only in tricostate genera and *Nicrophorus,* and is regarded as primitive for the Nicrophorini. The last type is peculiar to the *Nicrophorini* and, in the author's opinion, is the key to the elucidation of that genus.

Silpha.—The primitive condition of the genus is probably that with a simple tricostate elytra and a tuberosity between the second and third costæ about two-thirds of the distance to the apex. Among derivative types may be mentioned *Necrophila** and *Heterosilpha* in which the costæ tend to break up into a general reticulation, certain species of *Thanatophilus* with rows of tubercles between the costæ, *Ptomaphila* in which the striæ are broken up to form rows of tubercles, certain species of *Silpha* (s. str.)

* = *Necrobora* Hope 1840. *Necrophila* Kirby 1837 (type *Silpha americana* L., the same as *Necrobora*) is not a homonym of *Necrophilus* Latr. 1829, and, consequently, is the valid name for this subgenus.

in which the tuberosity is obsolete, *Philas* in which the striæ are obsolete, and *Silphosoma* in which the pronotum is abnormally reduced. *Phosphuga* and *Ablattaria,* far from deserving first place as in Portevin's classification, are among the most specialized groups of the genus. In both the elytral tuberosity is obsolete, the head is greatly narrowed, and the food consists of snails, in my view all specialized characters. *Ablattaria,* furthermore, has the elytral striæ obsolete.

Nicrophorini.—The bifasciate elytra of *Diamesus* and *Necrodes* (*Protonecrodes*) *surinamensis* ab. *bizonatus* Port. are probably homologous with those of *Nicrophorus,* and probably represent the acquisition of a new character, since this feature is entirely absent in *Silpha* and the lower Silphinæ. The Nicrophorini are further derivative in that (1) the second and third segments of the antenna have fused, leaving the antenna ten-segmented, (2) all evidence of the elytral costæ is wanting, (3) the legs are shorter and fossorial, (4) the antennal club is usually capitate, though simply clavate in *Ptomaphagus,* (5) the pronotum is frequently narrowed posteriorly, (6) the larvæ are eruciform and apparently present the first stages of a degeneracy similar to that exhibited by other larvæ leading their entire existence in the midst of their food supply (*e.g.,* fly-maggots and many Hymenoptera), in which there is a lessened need for agility or powers of rapid locomotion.

II. NECROPHILUS LATR.

KEY TO SPECIES

A1. Disc of pronotum sparsely punctate; rows of punctures on elytra impressed; intervals similar.

B1. Apex of elytra arcuate to suture, not prolonged; winged; metasternum long, normal; striæ equally punctate throughout; seventh interval not elevated at humerus; abdominal tergites largely membranous; length 9–11 mm.; Alaska to central California.

hydrophiloides Mann.

B2. Apex of elytra prolonged and abruptly bent downward; striæ with coarser punctures on apical and latero-apical portions; seventh interval elevated at humerus; length 10 mm.; New Zealand.

prolongatus Sharp.

A2. Disc of pronotum impunctate; elytra narrowly truncate at extreme apex; apterous; metasternum shorter.

B1. Elytral truncature sinuate, but without the sutural angle being sharply dentate; metasternum longer than metacoxa; rows of punctures on elytra feebly impressed, the second, fourth, and fifth intervals more prominent basally than the others; length 11 mm., rare (in fungi): Ont., Ind., Ohio, Ken., Tenn., N. C., N. Y. **pettitii** Horn.

B2. Sutural angle of elytra sharply dentate; metasternum shorter than metacoxa; rows of punctures on elytra distinctly impressed, intervals similar; abdominal tergites except first corneous; length 6–8 mm.; alpine regions of central Europe......**subterraneus** Dahl.

The Siberian *picipes* Mots. (Bull. Soc. Nat. Mosc. 1845, p. 52) of somewhat doubtful identity is not included. There is little doubt that *hydrophiloides* is more closely related to *subterraneus* Dahl. than to *Ecanus* Steph., on the basis of the characters set forth in the key to genera. *Subterraneus* and *pettitii* are about the only species of Silphinæ that, in their distribution, suggest a North Atlantic connection between North America and Eurasia. All the other affinities exhibited in the subfamily between the two regions can be better explained by way of Bering Strait.

III. SILPHA AND NECRODES

Portevin's revision, previously mentioned, includes the species belonging to the tribes Nicrophorini and Silphini of Ganglbauer. From the latter of these he segregates *Necrodes, Protonecrodes,* and *Diamesus* to constitute the *Necrodini,* and the sequence of the tribes is Silphini, Necrodini, Nicrophorini. Of Silphini he recognizes twenty genera and three subgenera, and of the other tribes three genera each.

While adhering to this sequence of tribes, I prefer to consider the twenty genera and three subgenera of Silphini all subgenera of a single genus, *Silpha.* Furthermore, I consider *Protonecrodes* a subgenus of *Necrodes* and *Necrocharis* a subgenus of *Nicrophorus. Acathnopsilus* represents a tendency within *Nicrophorus* of relatively slight significance and can be considered a synonym of that genus. With this one exception, the changes that I propose do not involve the validity or naturalness of any of Portevin's groups, but merely their relative rank. It is generally admitted that objective generic characters or objective genera do

not exist. The only objective criterion that can be applied is that a genus must contain no species that is less closely related to the type than to the species of some other genus. The argument in favor of the reduction of the genera mentioned above may be formulated as follows.

Genera are primarily for convenience, provided only that they be natural groups. Taxonomy must not become autotelic, but must serve as the handmaiden of the other biological disciplines. If the validity of the binomical nomenclature is granted, the demand of the general zoölogist and others who are not specialists in the several groups that generic names be sufficiently inclusive and characteristic to enable them to use and appreciate them is not an illegitimate one. Systematic zoölogy warrants their criticism if it fails to meet this demand. The requirement of the specialist for a more adequate grouping is entirely met by the introduction of subgenera and species-groups, which the general student can utilize at his discretion.

The same remarks apply to species. I tend to look upon a species as a group of interbreeding organisms that may exhibit considerable structural variation. Man, *Homo sapiens* L., is a typical species, and the differences between the several ''races'' or subspecies of man are typical of the degree of variation that may occur within a species. Subspecific variations that are correlated with geographical distribution may be termed *subspecies* or races. Other subspecific variations may be termed aberrations, though Portevin apparently recognizes three categories: (1) variations in color pattern or *aberrations,* (2) variations in sculpture and color of pubescence or *varieties,* and (3) variations in the general pigmentation of the exoskeleton or *accidents.* As will be seen in those portions of the present paper that treat of *Nicrophorus,* while retaining a comparatively conservative conception of species, I have insisted upon a rather minute classification of the aberrations. The species or, at most, the subspecies, will be all that will, presumably, concern the ecologist or general biology. Taxonomy would, however, fail in its primary descriptive function if it neglected to take cognizance of the variation which is considered aberrational, and the aberrations will be of

interest to those concerned with the problems of subspecific and individual variation.

In the following key to the Nearctic species of Silphini and Necrodini, *Necrodes* because of its orbicular pronotum is placed last, and *Oxelytrum* Gistel. is placed next to it because of its many necrodin features, as prominent eyes and elongate form. *Thanatophilus* is placed first because of its campodeiform larva, and, associated with it by the form of its labrum, is *Oiceoptoma* with its strongly blattiform larva, and *Philas,* larva unknown, with smooth elytra. The remaining subgenera with narrowly emarginate labrum are placed in the sequence *Blitophaga, Heterosilpha, Necrophila, Silpha* on the basis of their increasingly blattiform larvæ.

KEY TO NEARCTIC SILPHA* AND NECRODES

A1. Prothoracic spiracles covered; pronotum not orbicular..............**Silpha** L.

B1. Eyes not prominent; form less elongate.

C1. Labrum broadly emarginate; antennæ inserted close to eye and distant from margin of front.

D1. Elytra costate, not squarely truncate.

E1. Pronotum emarginate at base.

(**Thanatophilus** Sam.)

F1. Intervals of elytral costæ flat.

G1. Two inner elytral costæ subequal throughout; Alaska, Alb., Man., Minn., Mich.........**trituberculata** Kby.

G2. Two inner elytral costæ nearly obsolete at base; Colo., Brit. Col.

coloradensis Wick. (**obalskii** Port.)

F2. Intervals of elytral costæ tuberculate; arctic Europe and Asia, Greenland, Alaska,

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* In 1924 and 1925 a few individuals of *Silpha* (*Xylodrepa*) *quadripunctata* Schrb. were introduced from Europe into Massachusetts in the hope that they might establish themselves as predators on the gipsy moth (Crossman, Jr. Econ. Ent. XVIII, 1925, p. 172, and correspondence.) Mr. Crossman writes me, however, that no further attempt to introduce the species will be made, that it is of slight importance, the larvæ do not climb trees, no specimens have been recovered, and the species has probably not established itself. If taken, they may be distinguished from our other species by their light brownish elytra and basal and lateral marginal areas of the pronotum. The disc of the pronotum, scutellum, and two spots on each elytron, one basal and the other just behind the middle, are black.

Northwest Terr., and Labrador to D. C., Penn., Mich., Wisc., Iowa, Kans., New Mex., and Calif.; Mexico, (?) Bolivia.
lapponica Hbst.

G¹. Head and pronotum with long pubescence.

H¹. Base of elytra strongly punctate; humeri feebly dentate; north of Calif. and Mexico.
type.

H². Base of elytra finely punctate; humeri strongly dentate; Calif., (?) Bolivia.
subsp. *caudata* Say.

G². Head and pronotum with shorter pubescence; Mexico.
subsp. *granigera* Chev.

E². Pronotum not emarginate at base.
(**Oiceoptoma** Leach.)

F¹. Elytral punctation fine; pronotum unicolorous; Maine, Ont., northern penn. of Mich. and (?) Man. to Iowa, Kans., (?) Colo., and Fla.; Mexico and Guiana (Portevin).
inequalis Fab.

G¹. Color deep black.

H¹. Basal portions of elytra not rugose; humeral tooth feeble; inner two elytral costæ more elevated at apex; north of Georgia ....*type.*

H². Elytra rugose throughout; humeral tooth strong; elytral costæ equal throughout; Ga., Fla., Mexico and Guiana (Portevin).
subsp. *rugulosa* Port.

G². Color brownish with disc of pronotum somewhat darker; N. Y. (Type: Rosedale, L. I., F. M. Schott, June 30, 1918), N. J.....acc. *bicolorata* nov.

F². Elytral punctation coarser; pronotum black with reddish margins; N. S. and Man. through Iowa to Okla., Ill., Ind., and N. C.................................**noveboracensis** Forst.

D1. Elytra not costate; squarely truncate at apex; Ore., Colo. and Kans, to s.w. Tex. and n. Sonora, but not in Calif.; (?) Venezuela.
(**Philas** Port.) **truncata** Say.

C2. Labrum narrowly emarginate.

D1. Antennæ inserted close to margin of front and more distant from eye..............................(**Blitophaga** Reitt.)

E1. Form elongate-oval; surface pubescent; palaearctic, Man., Calif., (?) Colo., N. J......**opaca** L.

E2. Form oblong-oval; surface sparsely pubescent; Kans., Colo., Nebr., "Dak.", Wyom., Man., Mont., Idaho, Ore., Alb., Sask.....**bituberosa** Lec.

D2. Antennæ inserted close to eye and distant from margin of front.

E1. Body metallic below; elytral intervals reticulate.

F1. Oblong-oval; uniform black above.
(**Heterosilpha** Port.)

G1. Elytra not bronzed; elytral apex prolonged in ♀; Wash., Alb., Man., and Wisc. to Colo., N. Mex., n. Sonora, Calif., and Lower Calif...**ramosa** Say.

G2. Elytra and pronotum bronzed; elytral apex not modified in ♀; Calif.
aenescens Csy.

F2. Broadly oval; pronotum black with yellow margins; Man., n. Ont., and N. S. to Kans., N. Mex., and Fla.; Mexico and Guiana (Portevin).
(**Necrophila** Kby.) **americana** L.

G1. Elytra dark.

H1. Apex of elytra dark............*type.*

H2. Apex of elytra yellowish.
ab. *affinis* Kby.

G2. Elytra brownish; Md. (Type in Univ. of Minn. coll.).
acc. *brunnipennis* nov.

E2. Body not metallic below; elytral intervals not reticulate; alpine central Europe; (?) Kansas.
(**Silpha** L.) **tyrolensis** Laich.

B2. Eyes prominent; form elongate; pronotum black with roseate margins; Southern Calif. to Peru, Argentina, and Brazil.
(**Oxelytrum** Gistel.) **discicollis** Br.

A2. Prothoracic spiracles exposed; pronotum orbicular; form elongate; usually with orange bar or row of spots across elytra towards apex; eyes prominent; antennæ inserted close to eyes and distant from

margin of front; Nfld. and Alb. southward to the east of the Rocky Mts. through Mont. and Kans. to Ariz., Tex., La., and n. Georgia; n. South Amer. (Portevin).

Necrodes Leach (**Protonecrodes** Port.) **surinamensis** F.

B1. With evidence of basal elytral bar........................ab. *bizonatus* Port.

B2. Without evidence of basal elytral bar...*type.*

Distribution.—Of the nine Nearctic groups of Silphini and Necrodini, three (*Philas, Heterosilpha,* and *Necrophila*) are peculiar to its fauna with only one or two species each. One species (*discicollis* Br.), represented by a single specimen in the author's collection from southern California, belongs to the Neotropical *Oxelytrum* Gistel. The subgenus *Silpha* is represented by two specimens of *tyrolensis* ab. *nigrita* Creutz in the University of Minnesota collection labeled "Ka." from the Otto Lugger collection. The authenticity of this record is doubtful, and, if authentic, the specimens must have been artificially introduced from Europe. The remaining four groups are Holarctic. Of the 27 species of *Thanatophilus,* 15 are native to Palaearctic Asia, 9 to Europe, and 3 each to Ethiopian Africa and North America. Of the 5 species of *Oiceoptoma,* 3 are natives of Palaearctic Asia, 2 of North America, and one of Europe. Of the 13 species of *Blitophaga,* 10 are natives of Palaearctic Asia, 3 of Europe, and 2 of North America. The three species of *Protonecrodes* are distributed respectively in North America, Palaearctic Asia, and India. In every instance the center of distribution is Palaearctic Asia and the presumable connection with North America is by way of Bering Strait. In no instance, however, in contradistinction to the Lyrosomini and Agyrtini, are the Nearctic forms of these Holarctic groups peculiarly Pacific in distribution, and *Thanatophilus* is the only one of these groups to be represented on the Pacific Coast south of British Columbia.

Silpha (Thanatophilus) trituberculata Kby.—I found single specimens under cover on the sandy beach: two at Douglas Lake, Cheboygan Co., Mich., July 7 and 29, 1920; one at Cecil Bay, Emmet Co., Mich., July 23, 1920, on Lake Michigan. These are the only Michigan specimens known. I have no data on its habitat, but do not doubt that it is necrobious.

Silpha (Thanatophilus) coloradensis Wick.—*Obalskii* Port. is synonymous. Portevin has misinterpreted the original description and has grouped *coloradensis* with those species in which the elytral costæ are equal throughout. The species is probably generally but sparsely distributed throughout the Rocky Mountain area. Habitat unknown.

Silpha (Thanatophilus) lapponica Herbst.—Necrobious. Apparently absent from the southwestern counties of Michigan, and has not been recorded south and east of the states listed in the key.

Silpha (Oiceoptoma) inæqualis Fab.—Necrobious, breeding in southern Michigan beginning with March or early April. It apparently becomes rare towards the northern limits of its range, since extensive collecting at Douglas Lake, Mich., failed to reveal it, although it has been taken in the upper peninsula. I regard *rugulosa* Port. as the southern phase of this species, and there are specimens from Georgia in the University of Minnesota collection that appear to be intermediate.

Silpha (Oiceoptoma) noveboracensis Forst.—Necrobious, breeding in the spring. In southern Michigan both this species and *inaequalis* appear in numbers on carrion at the first opportunity in the spring. *S. inaequalis* appears first, is followed in a few days by *noveboracensis,* exists side by side with it for a few days, and then, having laid its eggs, entirely disappears, leaving the field to *noveboracensis* alone. I have taken a single specimen of *noveboracensis* in horse dung.

Silpha (Philas) truncata Say.—There is a series of five specimens of this species in the University of Minnesota collection that Dr. Oscar W. Oestland assures me were collected by one of his students in Venezuela.

Silpha (Blitophaga) opaca L.—This Palaearctic species has been reported from widely scattered Nearctic localities. My series of four specimens are said to have been taken in New Jersey. It is hardly to be regarded as a regular member of our fauna, and, since it is phytophagous, may possibly be transported with shipments of plants.

Silpha (Heterosilpha) ramosa Say and **aenescens** Csy.—According to taxonomic practice, these must be regarded as distinct species, since they differ as regards secondary sexual characters and both occur together in California. So far as I know, *ramosa* has not been recorded from Illinois, Iowa, and Nebraska or south or east of those states. The life history described by Goe (Ent. News XXX, 1919, pp. 253–255) under *S. inaequalis,* which does not occur in Oregon, is to be attributed to this species. It is necrobious, though Essig reports it as phytophagous from California.

Silpha (Necrophila) americanus L.—Necrobious. It is doubtful whether it is desirable to recognize by name variations in the discal pronotal spot. Four conditions have been noted: (1) spot single, widely separated from both fore and hind margins; (2) spot single, narrowly separated from fore margins, widely separated from posterior margin; (3) as in (2) except that spot is traversed by a narrow median yellow line; (4) spot single, narrowly separated from both anterior and posterior margin. I do not find any specimens exactly corresponding to *canadense* Kby., in which the spot is said to attain both anterior and posterior margins, unless my form (4) is it.

For the form with yellow-tipped elytra, I use the name *affinis* Kby. *Terminata* Kby. has page priority, but its use is rendered inadvisable because of the existence of *Silpha* (*Thanatophilus*) *terminata* Hummel, 1825. The aberration is much more abundant than the type, and it is possible that the type of *americana* L. really has the elytral apices yellow.

Necrodes (Protonecrodes) surinamensis Fab.—Necrobious. Females full of eggs occurred at Douglas Lake, Michigan, in July. The range of color variation is indicated by the accompanying table, in which the composition of the anterior fascia is indicated by Roman numerals and that of the posterior fascia by capital letters. A and I refer to marginal spots, B and II to spots on the outer costa, C and III to spots on the middle costa, D and IV to spots on the inner costa, and E to an extra sutural spot. When the symbols are connected by a dash the spots are confluent, otherwise they are distinct. An "x" indicates that specimens are known with the particular combination indicated.

	A–B–C–D	A–B–C D	A–B C D	A B–C–D E	A B–C–D	A B–C D	A B C–D	A B C D	A B C	B–C–D	B–C D	B C D	B C	B	C	No posterior fascia
I, III, IV								x								
I, II	x			x	x											
II	x								x			x				
I	x				x	x			x	x	x	x				
No anterior fascia	x	x	x		x	x	x	x		x	x	x	x	x	x	x

FOOD OF SILPHA, NECRODES, AND NICROPHORUS

The evidence* is at hand to show that the adults of these groups are primarily predators on fly-maggots. The carrion may, however, serve as a partial source of food, and I have kept imagoes of *Silpha* and *Necrodes* on a carrion diet for a period of several weeks. Observations on the larvæ are less numerous, but Goe raised larvæ of *S. ramosa* and I have raised larvæ of *S. noveboracensis* nearly to maturity on a purely carrion diet.

IV. NICROPHORINI

Material.—The following attempt to elucidate the interrelationships of the Nicrophorini is based on a collection the nucleus of which was secured from Mr. John W. Angell, of New York City, in 1922. The collection represented a decade's activity on his part, and, together with important additions received from him and others since that date, has enabled the author to see all but 20 of the 64 species recognized by Portevin. Of the remaining 20, five were unknown to Portevin, three were described from uniques and one from two specimens, and three seem to be doubtfully distinct. Of the species unknown to me, *lunatus* Fisch. is the only one I am unable to place in any of my groups, though I suspect its relationship to *humator* Fab. I place *argutor* Jak. in the *marginatus* group and *oberthuri* Port., *montivagus* Lewis, *validus* Port., *encaustus* Fairm., and *chilensis* Phil. in the *vespilloides* group. Species unknown to me except from descriptions are preceded by an asterisk (*) in the tables and notes that follow.

Primitive characters.—The following characters are regarded as primitive: (1) an orbicular pronotum; (2) a glabrous dorsal surface; (3) a "normal" size; (4) straight tibiæ on all three pairs of legs; (5) pronotum entirely black; (6) elytra with two simple fasciæ—it is in accordance with this that the simply bilobed mesal end of the posterior fascia is regarded as more primitive than the trilobed condition; (7) antenna with basal

* Clark, Jr. N. Y. Ent. Soc. III, 1895, p. 61; Davis, ibid, XXIII, 1915, p. 150–151; Steele, ibid, XXV, 1927, pp. 77–81; Goe, Ent. news XXX, 1919, pp. 253–255.

segment of the club black, the three distal segments orange; (8) ventral plates of meso- and metasternum with yellow pubescense; (9) abdominal sternites with black hairs; (10) surface of elytra moderately and uniformly punctate.

The argument may be summarized as follows:

(1) Those features are regarded as primitive that are present among other Silphinæ in general and Necrodini in particular. This argument is applicable to the first six characters mentioned and is the stronger argument. It is also applicable to number (7), which condition is present in *Necrodes littoralis* F.

(2) Those characters have been regarded as primitive that are in general occurrence among the species of *Nicrophorus,* so long as this evidence is not in conflict with the first, cited above. This applies to all but the first character mentioned.

Of derivative features, those that can be measured qualitatively, like the shape of the pronotum and the shape of the fasciæ in their "typical" form, seem more reliable indices of relationship and less likely to exhibit convergence than those that are measured quantitatively as the color of the ventral pubescence, the color of the segments of the antennal club, or the curving of the middle and hind tibiæ.

The Groups.—The following key is an attempt to define the chief phyletic groups of Nicrophorini.

KEY TO GROUPS OF NICROPHORINI

A1. Pronotum margined in part; antennæ capitate..............**Nicrophorus** Fab.
- B1. Pronotum orbicular, at times very feebly sinuate at sides; widely margined.
  - C1. Size "normal," usually under 25 mm. in length.
    - D2. Elytra with flying hairs; fasciæ not emarginate; Nearctic, Neotropical, Celebes. **orbicollis** group (7 species).
    - D2. Elytra without flying hairs.
      - E1. Elytra maculate; fasciæ emarginate; eastern Asia to New Guinea......**nepalensis** group (6 species).
      - E2. Elytra immaculate or with fasciæ greatly reduced; Palaearctic, (?) Calif. **humator** group (2 or 3 species).
  - C2. Size larger, usually over 25 mm.; posterior tibiæ often curved; Holarctic..................**germanicus** group (9 species).

B2. Pronotum transverse; sinuate at sides.

C1. Pronotum feebly sinuate, not strongly cordate, widely margined; posterior tibiæ straight.

D1. Three terminal segments of antennæ usually not orange; sutural extremity of posterior elytral fascia not trilobed; pronotum more quadrilateral; Holarctic, Oriental, Neotropical....**vespilloides** group (7 species).

D2. Three terminal segments of antennæ usually orange; sutural extremity of posterior elytral fascia normally trilobed; pronotum less quadrilateral; Holarctic.
pustulatus group (8 species),

C2. Pronotum strongly cordate, strongly sinuate at sides, less widely margined; posterior tibiæ straight or curved.

D1. Pronotum glabrous; sutural extremity of posterior elytral fascia normally trilobed; Holarctic.
marginatus group (10 species).

D2. Pronotum pubescent; sutural extremity of posterior elytral fascia not trilobed; Holarctic.
vespillo group (6 species).

B3. Pronotum oboval; lateral margin extremely narrow except at base; anterior sinuate line absent; mid-dorsal line feeble; Nearctic.
subg.**Necrocharis** Port. (1 species).

A2. Pronotum transversely oval; margin wide at base, extremely narrow at apical fourth; anterior sinuate and mid-dorsal lines obsolete; posterior elytral fascia obsolete, anterior one sometimes so; antennæ gradually clavate; eastern palaearctic..**Ptomascopus** Kr. (3 species and 1 fossil).

A3. Pronotum transversely oval, without margins; anterior sinuate and mid-dorsal lines obsolete; frontal striæ short; length 14.5 mm.; Lower Oligocene of France..............................**Palaeosilpha** Flach. (1 species).

Distribution.—Of the 10 phyletic groups of the tribe, 8 are eastern Palaearctic, 7 are Nearctic, 6 are western Palaearctic, 2 each are Neotropical, Oriental, and Celebean, and 1 extends to New Guinea. The only instance of discontinuous distribution is in the *orbicollis* group in which a single species is Celebean while the others are Nearctic and Neotropical. The situation is the same as in the other tribes of Silphinæ, with the center of dispersal in the eastern Palaearctic area, but the Nearctic Region is very nearly as important. All the groups occur in one or another of these two regions.

Phylogeny.—The *orbicollis* and *nepalensis* groups are the most primitive members of the genus. The *orbicollis* group appears

to be derivative in its possession of flying hairs on the elytra; the *nepalensis* group appears derivative in that the elytral fasciæ tend to be emarginate and to include black spots. The interpretation to be placed on the flying hairs is not evident. They are entirely different from the yellow pubescence of the *vespillo* group. Possibly they are primitive and the other groups have lost them; possibly, on their account, the *orbicollis* group must be considered divergent from the groups that otherwise appear to be descended from it.

Among the types of posterior elytral fasciæ in the *orbicollis* group, the feebly bilobed type in *orbicollis* appears to lead to the *vespilloides* group, the strongly bilobed type in *sayi* Lap., through its similarity with *americanus* Oliv. and *carolinus* L., appear to lead in the direction of the *germanicus* group and the subgenus *Necrocharis*. The trilobed type in *olidus* Matth. and *distinctus* Grouv. appears to lead in the direction of the *pustulatus-marginatus* groups, from which the type in the *vespillo* group can be derived by reduction.

The groups with a narrowed pronotum appear to represent two divergent lines: (1) that represented by the *vespilloides* group in which the pronotum is more distinctly quadrilateral; (2) that represented by the *pustulatus-marginatus-vespillo* groups in which the pronotum is more sinuate at the sides and becomes distinctly cordate. The affinity between the *pustulatus* and *marginatus* groups is exhibited by the similar trilobed posterior fascia. In the *vespillo* groups this latter feature is lost but the posterior fascia resembles that of the *pustulatus-marginatus* groups more closely than that of any other. Furthermore, the shape of the pronotum is very nearly that of some of the more generalized members of the *marginatus* group.

Ptomascopus and *Nicrophorus* represent divergent tendencies. As regards antennæ, *Nicrophorus* is the more derivative. As regards shape of pronotum and the elytral fasciæ, *Ptomascopus* is the more derivative.

Orbicollis Group

KEY TO SPECIES

A1. Posterior elytral fascia normally bilobed; pronotum more transverse (82% as long as wide); elytral pubescence longer.

B1. Posterior tibiæ straight; pronotum not emarginate at sides; posterior fascia with inner lobe small.

C1. Posterior trochanter normal, emarginate behind; marginal ridge of elytra attaining level of apex of scutellum; pronotum rounded at sides; Me., Ont., Man. and Alb. to Kans., Miss. and Fla...**orbicollis** Say.

C2. Posterior trochanter truncate behind; marginal ridge of elytra not attaining level of apex of scutellum; South America.

D1. Pronotum rounded at side; epipleura mostly black; marginal ridge of elytra longer; Mexico (Portevin) to Peru, Bolivia, and Argentina; Para (Brazil), Venezuela..**didymus** Brull.

D2. Pronotum visibly straight at sides; epipleura orange; marginal ridge not attaining basal half; Bolivia, Argentina..**scrutator** Blanch.

B2. Posterior tibia curved; pronotum very feebly wider in front and very feebly emarginate at sides; posterior fascia with inner lobe larger; N. B., Man., and Alb. through Mont. to Iowa., Ill., Tenn., Miss., and Va..**sayi** Lap.

A2. Posterior elytral fascia single; pronotum less transverse (86% as long as wide); elytral pubescence shorter; Costa Rica to Panama.
quadrimaculatus Matth.

A3. Posterior elytral fascia trilobed at sutural end; pronotum with a few hairs in anterior angles.

B1. Posterior tibia straight and simple; Mexico to Colombia.
olidus Matth.

B2. Posterior tibia curved and strongly dilated basally; Celebes.
distinctus Grouv.

Nicrophorus orbicollis Say.—Portevin states that the pronotum of fresh specimens bears traces of yellow pubescence, but I fail to find it in any of my extensive series. If it does exist, it might further substantiate the availability of this species as the type from which practically all the other species of the genus can be derived.

Nicrophorus didymus Brull.—Two specimens from Bolivia in my collection have the posterior fascia entire and the anterior one consisting of two spots and are hereby designated as ab. **portevini** nov.

Nicrophorus sayi Lap.—Appears to be rare south of the Illinois-Pennsylvania line, since Ulke does not record it from D. C. My two southern specimens bear the localities Suffolk, Va., and Marop, Miss.

Nicrophorus olidus Matth. and **distinctus** Grouv.—It may be supposed that the tendency to develop a trilobed posterior fascia was developed in the Holarctic area by the *orbicollis* group. Subsequently, from this stock, the *pustulatus* and *marginatus* groups arose in this region, leaving these peripheral species as the only evidence of the primitive fauna. The Celebean *distinctus* Grouv. possesses an abundance of unique features as is to be expected from its isolated habitat.

Nepalensis Group

The members of this group are distributed from eastern Siberia and Japan to northern India and New Guinea, but are not reported from the Philippine Islands. The following sequence more or less approximately indicates the relative specialization of the species: *nepalensis* Hope, *podagricus* Port., **heurni* Port., *quadrimaculatus* Kr., *maculifrons* Kr., and **maculiceps* Jak. Their extension into the Malay Archipelago is, perhaps, explained by an early geological development.

Humator Group

Includes *ussuriensis* Port., *humator* Fab., and, perhaps, *lunatus* Fisch. I am inclined to regard *tenuipes* Lew. as a subspecies of *humator*. The paratype of *Nicrophorus grandior* Angell from California is a somewhat immature specimen of *humator* Fab. so that, if this record is confirmed, this species must be added to the American list.

Germanicus Group

KEY TO SPECIES

A1. Apical angle of posterior tibia not prolonged in spine-like process.
B1. Posterior tibiæ simple; elytra fasciate.
C1. Disc of pronotum black; sides rounded; China. ***przewalskyi** Sem.
C2. Disc of pronotum orange; sides feebly sinuate, feebly enlarged in front; N. S. and Minn. through Iowa and Kans. to Tex. and Fla. .... **americanus** Fab.
B2. Posterior tibiæ dilated and dentate; sides of pronotum feebly enlarged in front.

C1. Elytra with hypomera, an anterior fascia, and a posterior spot orange; Russian Armenia, Central Russia.
*armeniacus Port.

C2. Elytra usually immaculate, at most with a few spots orange.

D1. Antennal club blackish.

E1. Clypeal membrane orange.

F1. Hypomera paler; posterior tibiæ feebly curved; elytra rarely with orange spots; Europe, (?) Calif.................**germanicus** L.

F2. Hypomera not paler.

G1. Posterior tibiæ nearly straight; central Russia, Turkestan, Mongolia, eastern Siberia, Japan....**morio** Gebl.

G2. Posterior tibiæ feebly curved; elytra with oblique striolæ; southern China.
***rugulipennis** Jak.

E2. Clypeal membrane black; Turkestan.
***nigerrimus** Kr.

D2. Last segments of antenna orange; central Russia, Turkestan ....**satanas** Reitt.

A2. External apical angle of posterior tibia prolonged in spine-like process; prontum rounded at sides.

B1. Lateral margin of pronotum without or with indistinct plica; clypeal membrane yellow; Japan, Formosa, northern China.
concolor Kr.

B2. Lateral margin of pronotum with distinct transverse clypeal membrane brown; Tibet, Himalayas, southern China.
rotundicollis Port.

The type of *Nicrophorus grandior* Angell from California is a specimen of *N. germanicus* ab. *bipunctatus* Kr. Portevin records a specimen of this form in the Grouvelle collection labeled "Etats-Unis."

Portevin's subgenus *Acathnopsilus* was erected to include *concolor* Kr. and *rotundicollis* Port., which, in my opinion, are only more or less derivative members of the *germanicus* group.

Vespilloides Group

Vespilloides Hbst. and *defodiens* Mann. are the only species of this group that I have seen. They are closely related, almost enough so for the latter to be considered the North American subspecies of the former. *Defodiens* occurs from Nfld., N. S.,

and N. J. through Que., Mich., Wisc., Minn., Man., Alb., and Mont. to central Calif. and Alaska.

KEY TO ABERRATIONS OF N. DEFODIENS MANN.

A1. Humeral end of hypomera orange.
- B1. Fasciæ not united on disc; N. J. to Alb.........ab. **humeralis** Hatch.
- B2. Fasciæ united on disc by double connection; Mich. (Type: Ag. Coll. 20, Aug. 1916 ....ab. **ruber** nov.

A2. Humeral end of hypomera black.
- B1. Posterior spot large; anterior spot not constricted.
  - C1. Fasciæ not united on disc.
    - D1. Anterior fascia not interrupted by suture; Me., N. Y., Ont., Minn., Dakota..**type.**
    - D2. Anterior fascia interrupted by suture; N. B., Me. (Type: Cumberland Co., A. Nicolay) ab. **nicolayi** nov.
  - C2. Fasciæ united by single connection; Ore. (Type: Baker City, Aug. 5, 1906) ....ab. **oregonensis** nov.
- B2. Posterior spot small.
  - C1. Anterior fascia continuous, constricted.
    - D1. Hypomera orange in part; B. C., Calif. (Type: Delnorte Co., V-29-10, F. W. Nunemacher). ab. **nunemacheri** nov.
    - D2. Hypomera black; Calif.....................ab. **binotatus** Port.
  - C1. Anterior fascia broken; posterior spot small.
    - D1. Inner end of anterior fascia large.
      - E1. Hypomera orange in part; Wash. to Cal. ab. **lateralis** Port.
      - E2. Hypomera black; Calif. (Type: Sonoma Co.) ab. **pacificae** nov.
    - D2. Inner end of anterior fascia reduced; Ore., Wash. (Type: Mason Co., Wash. Lake Cushman, vii-15-1919, F. M. Gaige 103).........................ab. **gaigei** nov.
    - D3. Inner end of anterior fascia absent; Cal., Ore. ab. **conversator** Walk.
- B3. Posterior spot absent.
  - C1. Anterior fascia not constricted; Alaska. *ab. **kadjakensis** Port.
  - C2. Anterior fascia constricted; Calif......ab. **mannerheimi** Port.

Pustulatus Group

KEY TO SPECIES

A1. Metasternal pubescence yellow, if black with immaculate elytra.
- B1. Metaepimeron glabrous.

C[1]. Elytral margin normal, not attaining humerus; hypomera orange or, if not, the elytra is immaculate; elytra without longitudinal raised lines.

D[1]. Abdominal pubescence yellow only at tip of pygidium; Palaearctic; in North America from Alaska and Man. through Colo. to N. Mex. and Calif., (?) Va. **investigator** Zett.

D[2]. Abdominal pubescence yellow over entire pygidium and along margins of propygidium; Japan. ***latifasciatus** Lewis

C[2]. Elytral margin much longer; hypomera faintly orange; elytra with distinct raised longitudinal lines; Kurile Is. and Sitka (Portevin), Man., Minn. and Newfoundland to Colo., Tex., and Fla., (?) Calif...............**pustulatus** Hersch.

B[2]. Metaepimeron pubescent; margin of pronotum somewhat narrower (as in *sepultor*).

C[1]. Hypomera entirely orange; abdominal hairs yellow; eastern Siberia, Japan...***praedator** Reitt.

C[2]. Hypomera with black; abdominal hairs yellow or black; Palaearctic ....**fossor** Er.

A[2]. Metasternal pubescence brown; abdominal pubescence black; never immaculate.

B[1]. Pronotum subquadrangular; Mexico: Durango, Michoacan. **mexicanus** Matth.

B[2]. Pronotum trapezoidal; Tibet, north China............**semenowi** Reitt.

Investigator Zett. is distributed from Europe eastward to central North America. Along the Pacific Coast from Japan to British Columbia the anterior fascia becomes reduced to form the subspecies *maritimus* Mann., and in California and Oregon, in the subspecies *nigritus* Mann., the elytra is immaculate.* Closely related to *investigator* Zett. is *pustulatus* Hersch., which occurs in eastern North America,* and might possibly be regarded as another subspecies. Portevin reports it likewise from the Kurile Is., and Sitkha, showing that its center of origin may be the same as *maritimus* Guer. It is similarly characterized by a reduction of the anterior fascia. Typical *investigator* is not entirely absent from the Pacific Coast (B. C. to Ore.) but is apparently not dominant there.

* There are in the author's collection single specimens of *nigritus* Mann. labeled ''Va.'' and of *pustulatus* Hersch. labeled ''Cal,'', but both records require confirmation.

KEY TO SUBSPECIFIC CATEGORIES OF *N. INVESTIGATOR* ZETT.

A¹. Elytra maculate; sternal pubescence yellow.
  B¹. Elytral fasciæ entire; throughout range of species except region from Japan to Calif..............................subsp. **investigator** (s. str.)
    C¹. Elytral fasciæ not united on disc.
      D¹. Hypomera orange.
        E¹. Punctation normal ....**type.**
        E². Punctation coarse, dense, confluent; fasciæ large. *var. **variolosus** Port.
      D². Hypomera with black spot towards base.
        E¹. Black spot small.
          F¹. Posterior fascia confluent with hypomera, Moravia, Ariz., N. M., Man., Utah, Ore., Wash., Alb., B. C.....ab. **intermedius** Reitt.
          F². Posterior fascia not confluent with hypomera; Ariz., N. Mex. (Type: Hot Springs, 7000 ft. alt.), Wash., Mont. ab. **jamezi** nov.
        E². Black spot large so that entire humeral portion of hypomera is black except a narrow margin. *ab. **funeror** Reitt.
    C². Elytral fasciæ united on disc; Ariz., N. Mex. ab. **lutescens** Port.
  B². Anterior fascia more or less reduced; Japan to B. C. subsp. **maritimus** Guér.
    C¹. Discal portion of anterior fascia continuous with hypomera.
      D¹. Anterior fascia attaining suture; B. C. (Type: Massett, Sept. 1925, Jack Martin col.)......ab. **martini** nov.
      D². Anterior fascia not attending suture; B. C. (Type: Massett, July 26, 1925, Clarence Martin col.) ab. **clarencei** nov.
    C². Discal portion of anterior fascia not continuous with hypomera.
      D¹. Anterior fascia with 3 free elements: 2 discal, 1 sutural; B. C., Alaska ....**type of subspecies.**
      D². With 2 free elements, discal and sutural; Sitka (Type: Sitk. 578), B. C...............................ab. **sitkenensis** nov.
      D³. One free discal element; B. C. (Type: Massett, July 26, 1925, Clarence Martin col.)........ab. **massetti** nov.
      D⁴. One sutural element; B. C. (Type: Massett, July 26, 1925, Clarence Martin col.)............ab. **grahami** nov.
      D⁵. One element, sutural plus discal; B. C. (Type: Massett, Sept. 1925, Jack Martin col.) ab. **charlottei** nov.

C³. Discal portion of anterior fascia absent.
D¹. Posterior fascia entire; Turcmenie, Sitka, B. C. ab. **particeps** Fisch.
D². Posterior fascia divided; Japan (Type) ab. **japani** nov.
A². Elytra immaculate; sternal pubescence brown; Calif., Ore. subsp. **nigritus** Mann.
B¹. Abdominal pubescence yellow; Calif. ....*var. **ruficornis** Mots.
B². Abdominal pubescence black; Calif., (?) Va. ....**type of subsp.**

KEY TO ABBERATIONS OF *N. PUSTULATUS* HERSCH

A¹. Discal element of anterior fascia present.
B¹. Spots of posterior fascia joined; Colo. (Type) ab. **coloradensis** nov.
B². Spots of posterior fascia separate; N. Y. (Type: Amagansett, L. I., W. T. Davis. Sept., 1916)..............ab. **noveboracensis** nov.
A². Discal element of anterior fascia absent.
B¹. Spots of posterior fascia joined; Ken., Que., N. Y., Fla. ab. **fasciatus** Port.
B². Spots of posterior fascia separate; throughout range of species, (?) Calif. ....**type**
B³. Elytra immaculate; La. (Univ. of Minn. coll.) ......ab. **unicolor** Port.

Marginatus Group

KEY TO SPECIES

A¹. Posterior tibiæ straight; margin of pronotum narrower than in *pustulatus* but wider than in the other species of this group; pronotum finely punctate.
B¹. Pronotum feebly cordate; sternal pubescence yellow throughout; base of hypomera with black spot; Europe to Lake Baikal. **sepultor** Charp.
B². Pronotum more strongly cordate; sternal pubescence dark at sides; base of hypomera with black spot.
C¹. Sternal pubescence yellow at middle; northern Mongolia, eastern Siberia ....**pseudobrutor** Reitt.
C¹. Sternal pubescence dark at middle; China....*confusus Port.
B³. Pronotum very strongly cordate; sternal pubescence yellow throughout; hypomera entirely orange; Wash., Mont., Man., Minn., (?) N. M. and (?) N. J. ....**hybridus** Hatch and Angell
A². Posterior tibiæ very feebly arcuate on inner margin, sinuate on outer margin; disc coarsely punctate, margin narrow; anterior lines of pronotum nearly attaining mid-dorsal line.
B¹. Abdominal hairs black; Alas. and Calif. to Man., Wyom., Colo., Kans., and N. Mex. ....**guttulus** Mots.

B2. Abdominal hairs yellow; northern China, eastern Siberia.
basalis Fald.

A3. Posterior tibiæ strongly arcuate along both margins; disc of pronotum less strongly punctate, margins narrow; anterior lines of pronotum not attaining mid-dorsal line.
- B1. Margin of thorax wider; abdominal hairs yellow; central China, Mongolia, Chosen, Japan, Formosa ....**japonicus** Har.
- B2. Margin of pronotum narrower; abdominal hairs black.
  - C1. Basal segment of antennal club black; Man., N. D., S. D., Ore., Ut., Minn., Wisc. ....**obscurus** Kby.
  - C2. Antennal club orange; Me., Man., Alb., and Ore. to Calif., Tex., and Miss.; Mexico and Central America (?) **marginatus** Fab.

Nicrophorus hybridus Hatch and Angell.—The New Mexico and New Jersey records are founded on single specimens and require confirmation. A single specimen from Minnesota (Ramsey Co.) with entirely black antennæ—in the typical form only the basal segment is black—exists in the University of Minnesota and constitutes the var. *minnesotianus* Hatch.

Nicrophorus guttulus Mots.—Along the Pacific Coast from Oregon to California this species is represented by the subspecies *guttula* (s. str.), in which the basal segment of the antennal club is black and the elytral markings reduced or absent. Throughout the rest of its range occurs the subspecies *hecate* Bland., in which the antennal club is entirely orange and the maculation normal. However, some forms of *hecate* (*californicæ* from California and *intermedius* from Oregon and Nevada) occur in the same region as *guttula* (s. str.), and their reduced maculation would seem to show that this rather than the color of the antennal club is the geographically significant variation.

KEY TO SUBSPECIFIC CATEGORIES OF *N. GUTTULUS* MOTS.

A1. First segment of antennal club black; Ore., Calif.
subsp. **guttulus** Mots.
- B1. Anterior fascia continuous with hypomera.
  - C1. Posterior fascia single; Cal. (Type: Sonoma Co., Mar. 25, 1912) ....ab. **punctatus** nov.
  - C2. Posterior fascia in two parts; Cal. (Type: Shasta Co., May, 1914) ....ab. **shastæ** nov.
- B2. Anterior fascia discontinuous, in two parts.

C1. Posterior fascia bilobed.
D1. Hypomera red; Cal. ....ab. **quadriguttatus** Angell.
D2. Hypomera black behind humeral spot; Cal. (Type: Shasta Co., May, 1914) ....ab. **hypomerus** nov.
C2. Posterior fascia divided; Cal. (Type: San Francisco, VIII–26–1911) ....ab. **sanfranciscæ** nov.
B3. Anterior fascia wanting.
C1. Posterior spot present.
D1. Hypomera red; Cal. ....ab. **vandykei** Angell.
D2. Hypomera dark behind humeral spot; Cal. (Type: San Francisco, VIII–26–1911, J. A. Kusche col.) ab. **kuschei** nov.
C2. Posterior spot absent.
D1. Hypomera red; Cal. (Type: San Francisco, VIII–26–1911, J. A. Kusche col.) ....ab. **lajollæ** nov.
D2. Hypomera dark behind humeral spot; Ore., Cal. **type of subsp.**
A2. Antennal club orange; throughout range of species except coast from Ore. to Cal. (but cf. *californiæ intermedius*, and *immaculosus*). subsp. **hecate** Bland.
B1. Fasciæ not united on disc.
C1. Anterior fascia entire.
D1. Posterior fascia continuous with hypomera; B. C., Wash., Ore., Wyom., Ut., Colo., N. M. ....**type of subsp.**
D2. Posterior fascia not extending to lateral margin.
E1. Posterior fascia elongate; B. C. (Type: Peachland, B. C., 3–VIII–12, J. B. Wallis, under carrion), Ore., Nev., N. M., Wyom. ....ab. **wallisi** nov.
E2. Posterior fascia a round spot; Cal. (Type) ab. **californiæ** nov.
C2. Anterior fascia discontinuous.
D1. Posterior fascia single, anterior in two parts; Ore., Nev. ....ab. **intermedius** Angell.
D2. Posterior fascia in two parts, anterior in three parts. ab. **disjunctus** Port.
B2. Fasciæ united on disc.
C1. Connection of fasciæ single.
D1. Posterior black spot of elytra not constricted.
E1. Connection of fasciæ narrow; Colo., N. M. (Type: Jamez Springs, N. M., 1915, John Woodgate) ab. **woodgatei** nov.
E2. Connection of fasciæ broad; Ariz. (Type: Phoenix), Colo., N. M., Nev. ....ab. **phoenix** nov.
D2. Posterior black spot on elytra nearly divided; Colo., N. M. (Type: Fort Wing, N. M.) ....ab. **novamexicæ** nov.
C2. Connection of fasciæ double.

D1. With dark sutural space; N. M., Cal., Kans.
ab. **rubripennis** Port.

D2. Without dark sutural space; Colo. (Type)
ab. **rubrissimus** nov.

B3. Disc immaculate; Calif. (Type in collection of Deutsche Entomologische Institut ....ab. **immaculosis** nov.

KEY TO ABERRATIONS OF *N. OBSCURUS* FAB.

A1. Elytral fasciæ not continuous on disc.

B1. Posterior fasciæ entire ....**type**

B2. Posterior fasciæ divided, with sutural lobe reduced to 2 free spots, anterior fascia broken; Utah (Type in collection of Phil. Acad. Nat. Sci.) ....ab. **discontinuus** nov.

A2. Elytral fasciæ continuous on disc; Ore. (Type: Portland, Ore., 7–16–1917, M. T. Goe col.), Wisc. ....ab. **ruber** nov.

KEY TO ABERRATIONS OF *N. MARGINATUS* FAB.

A1. Elytral fasciæ not connected on disc.

B1. Both fasciæ continuous, posterior one extending more than half way to suture ....**type**

B2. Anterior fascia discontinuous; Colo. (Type: Oslar, San Juan Mts., Colo.), Wisc., N. Y. ....ab. **sanjuanæ** nov.

B3. Posterior fascia discontinuous; Cal. (Type: La Jolla, San Diego Co., Cal., 1924, Engelhardt col.) ....ab. **engelhardti** nov.

B4. Posterior fascia abbreviated, extending less than half way to suture; Cal. (Type: San Francisco, VII–16–1911)
ab. **leachi** ov.

A2. Elytral fasciæ connected on disc; N. Y., Ark. ....ab. **cordiger** Port.

The aberrations *engelhardti* and *leachi* from California exhibit the same tendency towards a reduction of the elytral fasciæ as is seen in other species in this region.

Vespillo Group

KEY TO SPECIES

A1. Pronotum pubescent throughout; posterior tibiæ straight.

B1. Pronotum sparsely pubescent on disc.

C1. First segment of antennal club black; Europe to Mongolia.
vestigator Hersch.

C2. Antennal club orange; central Europe to Mongolia.
antennatus Reitt.

C3. Antennal club black; Mongolia, eastern Siberia.
dauricus Mots.

B2. Pronotum densely pubescent on disc; antennal club black; Me., Ont., Man., Mont., and Ore., through Colo. to (?) Lower Calif., Ariz. and Georgia ....**tomentosus** Web.*

A2. Pronotum pubescent in front only; posterior tibiæ curved.

B.1. First segment only of antennal club black; posterior tibiæ strongly curved; Palæarctic, northern India, (?) Nebr. and Penn. (Portevin) ....**vespillo** L.

B2. Antennal club black; posterior tibiæ feebly curved; central Europe, Greece, Caucasus ....**nigricornis** Fald.

Nicrophorus vestigator ab. **abbrevius** nov.—Those specimens in which the posterior fascia attains neither the hypomera or suture are so designated. My specimens are from England (Type: s. coast, England) and Germany.

Nicrophorus antennatus ab. **transbaikali** nov.—A single specimen in my collection from the Transbaikal in which the posterior fascia fails to attain the suture.

KEY TO ABERRATIONS OF *N. TOMENTOSUS WEB.*

A1. Fasciæ not confluent on disc.

B1. Fasciæ joined on hypomera.

C1. Posterior fascia entire.

D1. Posterior fascia not interrupted at suture ....**type**

D2. Posterior fascia interrupted at suture (Type: Wyandanche, L. I., Oct. 10, 1915, F. M. Schott) ab. **communis** nov.

C2. Posterior fascia with free sutural spot. *ab. **angustefasciatus** Port.

B2. Fasciæ joined mesad of hypomera; Colo. (Type: Littleton, Colo. VI–24–11, C. A. Frost, dead bird) ....ab. **elongatus** nov.

A2. Fasciæ continuous on disc.

B1. Elytral disc with single dark spot; Ariz. (Type: Flagstaff, Ariz.) ....ab. **splendens** nov.

B2. Elytral fasciæ forming a solid discal mass (on one elytron only); Man. (Type: Aweme, Man. 14–VIII–06, Criddle). ab. **brevis** nov.

Nicrophorus vespillo ab. **germani** nov.—A single specimen from Germany in which the posterior elytral fascia fails to attain the sutural bead of the elytra.

Subg. **Necrocharis** Port.

Carolinus L., the single species of this group, occurs in N. C., Fla., La., Tex., N. Mex., Ariz., Okla., Kans., Nebr., and (?) Penn.

* Sherborn (Index Animalium, 1922, p. cxxviii) says that Weber, Obs. Ent. 1801, probably antedates Fabricius, Syst. Eleut. I, 1801, giving *tomentosus* Web. priority over *velutinus* Fab.

KEY TO ABERRATIONS OF *N. CAROLINUS* L.

A¹. Elytra maculate.
  B¹. Hypomera orange, at least at base.
    C¹. Basal fascia entire.
      D¹. Basal fascia extending on to hypomera.
        E¹. Basal fascia and humeral spot broadly connected. **type**
        E². Basal fascia and humeral spot narrowly connected; N. C. (Type: Southern Pines, N. C., VI–28–16, A. H. Manee), Fla. ....ab. **floridæ** nov.
      D². Basal fascia not extending on to hypomera.
        E¹. Apical lunule without partially enclosed spot immediately anterior; N. C., Fla. ab. **scapulatus** Port.
        E². Apical lunule partially enclosing a spot immediately anterior; Fla. (Type: Stemper, Fla., George Krautwurm)....................ab. **krautwurmi** nov.
    C². Basal fascia divided.
      D¹. Hypomera orange; N. M. (Type: Tbu'que, N. M., 70–10–88 ....ab. **lunulatus** nov.
      D². Hypomera black except cephalad; Neb., Kans. (Type), N. M. ....ab. **nebraskæ** nov.
  B². Hypomera entirely black ....*ab. **dolosus** Port.
A². Elytra immaculate; hypomera black, faintly orange cephalad; Ariz. ab. **mysticalis** Angell

Ptomascopus Kr.

KEY TO SPECIES

A¹. Occiput densely punctate; elytra with 3 or 4 rows of large punctures; pronotum with a basal fovea on either side of middle.
  B¹. Elytra densely punctate, with a single anterior fascia.
    C¹. Less shining, more pubescent; 15 mm. long; northern China, Japan ....**plagiatus** Mén.
    C². More shining, less pubescent; eastern Siberia. ***weberi** Boden.
  B². Elytra finely punctate, immaculate; 15 mm. long; northern China, Japan, Formosa ....**morio** Kr.
A². Occiput less densely punctate; elytra densely punctate; large punctures wanting from elytra; basal pronotal foveæ scarcely evident; color of elytra unknown; 14.5 mm. long; Lower Oligocene of France. ***aveyronensis** Flach.

V. FOSSILS

Are there Mesozoic Silphinæ?—Two types of elytra may be suspected in this connection: (1) nine-striated elytra of caraboid facies without a sutural stria; (2) tri-costate elytra.

The nine-striated elytron represents a generalized type widely distributed in Carabidæ and Tenebriondæ. Both these families have a sutural stria, which is absent in Lyrosomini and Agyrtini. *Pseudocarabites deplanatus* Heer (Handlirsch, Foss. Ins. 1908, p. 401, Taf. XXXIX, fig. 9), founded on a nine-striated elytron 5 mm. long, from the Upper Trias of Sweden, may possibly be suspected of lyrosomin or agyrtin affinities. However, the basal portion of the elytron appears to be lost, so that the existence of a sutural stria is indeterminable.

The tri-costate condition is found in several of the elytra figured by Handlirsch (*ibid.*), to wit, Taf. XLI, fig. 62, 75; Taf. XLV, fig. 6, 27, 61, 63, 77. None of these, however, except the last, exhibit the large scutellum that is characteristic of *Silpha,* and this appears to be too convex to admit it to this group. Furthermore, the pronotum of Taf. XLV, fig. 6 makes it inadmissible. Taf. XLI, fig. 75 is a fragment showing an elytral apex. In its convergent striæ and apparently narrow elytra it more closely resembles such a buprestid as *Buprestes striata* than *Silpha.*

I find nothing suggesive of *Nicrophorus* in any of the mesozoic fossils figured.

AGYRTINI

Agyrtes Fröl.

A. primoticus S. Scudder (fig. 1) (Adephagous and Clavicorn Coleoptera from the Tertiary deposits at Florissant, Colorado. U. S. G. S. Mong. XL, 1900, p. 45, pl. V, fig. 6) Upper Miocene of Florissant, Colo. Length 8 mm., bredth 4.1 mm. Elytra nine-striate; antennæ clavate. Pronotum as wide at base as elytra with sides feebly arcuate, about 55 per cent. as long as wide at base, and with apex somewhat narrower than base. The subquadrate pronotum reveals this as *Agyrtes,* though none of the living species attains a length of more than 5 mm.

Miosilpha Wick.

M. necrophiloides Wickham (fig. 2 and 3). (A report on some recent collections of fossil Coleoptera from the Miocene shales of Florissant. Bull. Univ. of Ia. Lab. Nat. Hist. VI (3), 1912, p. 9, pl. I, fig. 5, 6.) Length to apex of abdomen 9 mm., length of elytra 3.5 mm. Sufficiently defined above in the key to the genera of Silphinæ.

Ipelates Reitt.

Klebs (Schr. Phys. ökon. Gesell. Königsburg LI, 1910, p. 241) records an unidentified species of this genus from the Lower Oligocene of Baltic Amber. The identification was by Reitter.

SILPHINI

Silpha L.

Subg. *Oeningosilpha* nov.

Silpha (Oeningosilpha) tricostata Heer (fig. 4). (*Peltis tricostata* Heer, Die Insektenfauna der Tertiargebilde von Oeningen und von Radoboj in Croatien. Käfer. Mem. Soc. Helv. sci. nat., Neuchatel, VII, 1845, pp. 39–40, pl. VII, fig. 34.) Based on an elytron 5⅝ lines (14.15 mm.) long from the Upper Miocene of Oeningen, Baden. The subgenus *Oeningosilpha* (type *Peltis tricostata* Heer) is distinguished from the other recent subgenera by the fact that the distance between the margin and the outer stria of the elytron is equal to that between the outer stria and the suture. In recent subgenera the first distance is less than the second. The pronotum is unknown, and, if it should be orbicular, would require the inclusion of this subgenus in *Necrodes*.

Subg. *Thanatophilus* Sam.

Silpha (Thanatophilus) dispar Herbst is merely mentioned by Heer (Die Urwelt der Schweiz, 2nd ed., 1883, p. 581) from the Pleistocene and by Alfred Bell (Post-glacial insects, Entom. XXI, 1888, p. 2) from the Norfolk Forest bed.

Subg. *Blitophaga* Reitt.

Silpha (Blitophaga) vestusta A. M. Lomnicki (fig. 5) (Pleistocenskie Owady z Boryslawia (Fauna pleistocenica Insectorum Boryslaviensium). Museum Im. Dzieduszyckich IV. Lemberg, 1894, p. 76, pl. 7, fig. 59). Lower Pleistocene of Boryslaw, Galicia.

Silpha (Blitophaga) reitteri Lomnicki (fig. 6) (*ibid.*, p. 77, pl. 7, fig. 60). Lower Pleistocene of Boryslaw, Galicia.

The transverse pronotum, feebly narrowed and not emarginate in front reveal these as *Blitophaga.* The basal margin of the pronotum is represented as being straighter and less sinuate than in any of the living species I have seen, but this is a more or less evanescent character that figures cannot always be relied upon to depict accurately. The two species are distinguished by size and by the varying extent of the inner elytral costa. I do not feel sufficiently familiar with the numerous species of *Blitophaga* to discuss their detailed relationships.

Subg. *Silpha* (s. str.)

S. beutenmuelleri Wickham (fig. 7) (New Miocene Coleoptera. Bull. Mus. Comp. Zool. LVIII, 1914, p. 428, pl. I, fig. 3). Upper Miocene of Florissant, Colo. Described from a coarsely punctate elytron a trifle over 10 mm. long. From the figure one would suppose that there were four entire costae, but the author says that the outer of these is a deep marginal groove, and he compares it with the living *tyrolensis.* The great distance of the groove and the outer costa from the margin, the entire outer costa, and the obsolescence of the elytral tuberosity appear to distinguish this fossil from any of the living species known to me. It is almost certainly a member of the subgenus *Silpha,* a group which is now confined to the Palaearctic region with three species in Ethiopian Africa. As regards development and position of the groove, it approximates *carinata,* but in that species the outer costa is abbreviated apically.

NECRODINI

Necrodes Leach

Subg. *Mionecrodes* nov.

Necrodes (Mionecrodes) tricostata Heer (figs. 8 and 9) (*Silpha tricostata* Heer, Beitrag zur Insekten-fauna Oeningen, Coleoptera. Naturk. Verh. Hollandsche Maatsch. Wetensch. Haarlem XVI, 1862, pp. 50–51, pl. III, figs. 7–8). Upper Miocene of Oeningen, Baden. The position of the outer elytral costa nearer the margin than the suture shows that this is not the same as *Peltis tricostata* Heer 1845 (*Oeningosilpha* above). The oval pronotum of Heer's fig. 7 (fig. 8) places it in *Necrodes,* but it is separated from the living species by the broader, less elongate, entire (not truncate) elytra. With this species Heer associated the specimen depicted in fig. 9. The pronotum of the second specimen is unknown. I detect differences between the two, but hesitate to recognize two species.

Subg. (?) *Protonecrodes* Port.

Necrodes primaevus Beutenmüller and Cockerell (in Cockerell, Fossil Insecta from Florissant, Colorado. Bull. Amer. Mus. Nat. Hist. XXIV, 1908, p. 67, pl. C, fig. 1). Upper Miocene of Florissant, Colo. Length 17 mm. Elytra 11 mm. long. Similar to *surinamensis* Fab., but with shorter elytra. The half-tone figure is not good and a restudy of the type might reveal additional features.

NICROPHORINI

Ptomascopus Kr.

P. aveyronensis K. Flach (fig. 10) (Ueber zwei fossile Silphiden Coleoptera) aus den Phosphoriten von Caylux. Deut. Ent. Zeit. 1890, p. 106, Taf. I, fig. 2). Lower Oligocene of the Phosphorit of Aveyron von Caylux, southern France. Sufficiently described above in the key to the species of *Ptomascopus.*

Palaeosilpha Flach

P. fraasii Flach (fig. 11) (*ibid.,* pp. 106–107, Taf. I, fig. 1). Lower Oligocene of the Phosphorit of Aveyron von Caylux,

southern France. Sufficiently described above in the key to the groups of Nicrophorini.

NOT SILPHINAE

Staphylinidae

Silpha stratuum Germar (Fauna Insectorum Europae XIX, 1837, tab. 5). This is not Silphinae, because five or six abdominal tergites are exposed by the slightly transverse elytra. I do not attempt to place it further.

Ostomidae

Phosphuga atrata Flach nec L. (Die Käfer der unterpleistocänen Ablagerungen bei Hosbach unweit Aschaffenburg. Verh. Phys. Med. Gesell. Wurzburg, N. F. XVIII, 1884, p. 9, pl. IX, fig. 6). Based on a single elytron. The small scutellum makes the assignment of this species to any of the living subgenera of *Silpha* impossible, and it is this character which I rely upon to establish its cogenericity if not its cospecificity with *Zimioma grossa* L. Of course, there is a possibility that this is the remains of a *Silpha* with a small scutellum, but the above assignment seems the more probable.

Melandryidae

Silpha colorata Scudder (*ibid.,* p. 44, pl. V, fig. 5). The absence of striae or costae, and the finely pubescent, narrow, and apically rounded elytra make the assignment of this fossil to Silphinae impossible. The only living species with which I can compare it is *Emmesa connectens* Newm., from which it is separated by the failure of the apical spot to attain the apex of the elytra.

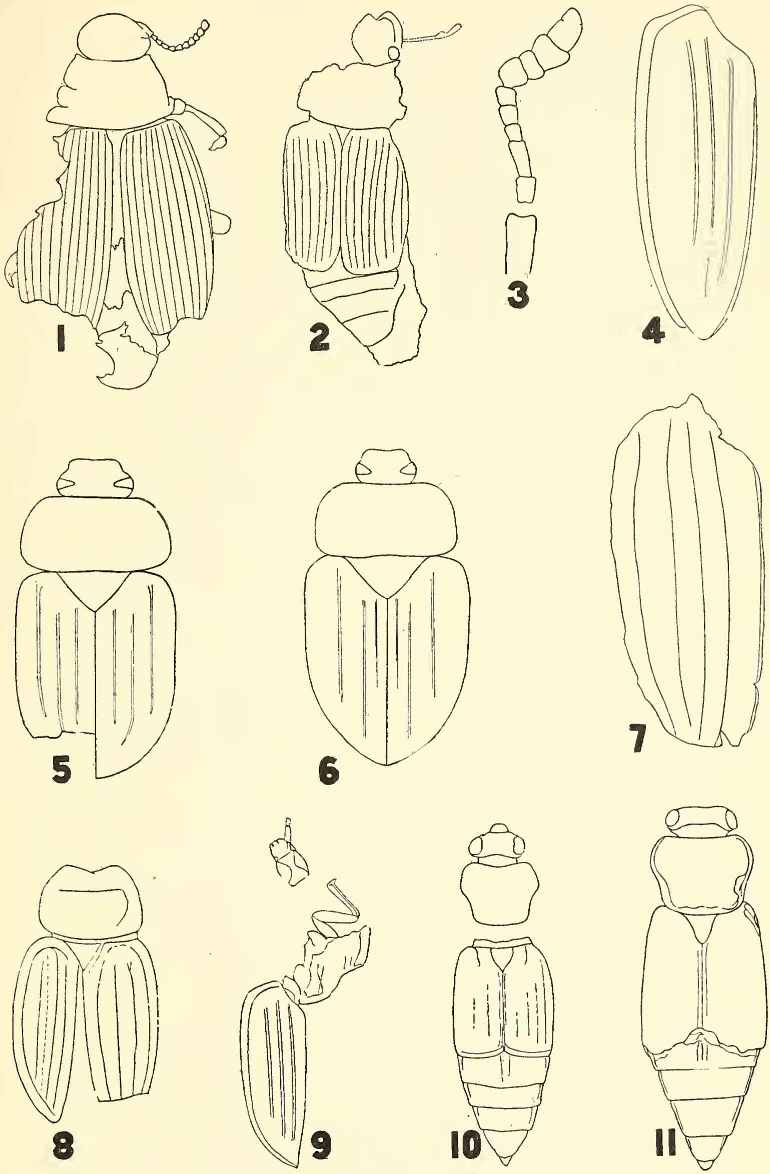
Coleoptera incertae sedis

Silpha obsoleta Heer (1845, *ibid.,* p. 36, pl. II, fig. 7). This species is founded on an impression showing a head, pronotum, and apparently a portion of the elytra. No suture is revealed and no sculpture is present. To attempt the classification of such an object is folly!

Silpha ? deplanata Heer (Die Miocene Flora und Fauna Spitsbergen, K. Svenska Vet. Ak. Handl. VIII (7), 1870 (1869), p. 73, pl. 16, fig. 42). Based on the fragment of an elytron about 11 mm. long and 5 mm. wide. Flat with a broad margin and a number of flat longitudinal ridges which Heer says is five, but which is indeterminable from the figure. I do not believe the assignment of this fossil to *Silpha* is warranted. No quintecostate recent silphine is known. At best, such a condition is a more or less generalized one, found in several families.

EXPLANATION OF PLATE XVI

Figure 1: *Agyrtes primoticus* Scudder (1900, Pl. V, Fig. 6); Figures 2–3: *Miosilpha necrophiloides* Wickham (1912, Pl. I, Figs. 5, 5a); Figure 4: *Silpha* (*Oeningosilpha*) *tricostata* Heer (1845, Pl. VII, Fig. 34); Figure 5: *Silpha* (*Blitophaga*) *vetusta* Lomnicki (1894, Pl. 7, Fig. 59); Figure 6: *Silpha* (*Blitophaga*) *reitteri* Lomnicki (1894, Pl. 7, Fig. 60); Figure 7: *Silpha* (s. str.) *beutenmuelleri* Wickham (1914, Pl. I, Fig. 3); Figures 8–9: *Necrodes* (*Mionecrodes*) *tricostata* Heer (1862, Pl. II, Figs. 7–8); Figure 10: *Ptomascopus aveyronensis* Flach (1890, Taf. I, Fig. 2); Figure 11: *Palaeosilpha fraasii* Flach (1890, Taf. I, Fig. 1).



SILPHINAE

NEW CICADAS FROM THE WESTERN UNITED STATES WITH NOTES ON SEVERAL OTHER SPECIES

By Wm. T. Davis
Staten Island, N. Y.

It appears likely that the cicadas from Nova Scotia to Florida on the Atlantic coast, and for some distance inland, are fairly well known; that is, it seems probable that about all of the species are known. As regards distribution, habits and life cycles, there is of course very much to learn. The cicadas of the eastern states embrace many large species of *Tibicen,* and this condition exists until the neighborhood of that interesting line, the one hundredth meridian, is reached, when the smaller species belonging to the genera *Okanagana, Clidophleps* and *Platypedia* become quite numerous, and *Tibicen* is represented only to a slight extent. It is among these genera in the Pacific states, and those immediately adjoining to the eastward, that new forms are most often met with, and as many of the species evidently have but a small distribution, it will probably be some time before they are as well known as those of the Atlantic coast that generally have a wider distribution.

While in the Seventeen-Year and Thirteen-Year cicadas, the periods of the various broods are known and attract attention, it is equally true that there are cicada years among the other species as well, though not so pronounced. A conspicuous example of this kind, to which the writer can testify, was the year 1921 at Wingina, Nelson County, Virginia, when in August cicadas of several species, such as *winnemanna, auletes* and *lyricen* would join at evening in a continuous chorus in the trees about the house. August, 1927, was a great contrast; there was no evening chorus and a cicada of any kind was a rarity. In August, 1921, Colonel Robinson collected thirty-six *Tibicen robinsoniana* with the shotgun, while in 1927 the gun was not once taken afield, for the cicadas were not to be seen. Even the usual common *Tibicen*

chloromera was scarce. It would seem from this and other like experiences, that a number of our larger cicadas appear together, that their life periods are of the same duration, and that we in consequence have cicada years. There is some advantage to a species, or several allied species, to appear together, and give their mutual enemies some starvation years in between. It appeared that the Cicada Killer, the hornet *Specius speciosus,* that requires but a year for its life cycle, made out but poorly at Wingina in 1927; we saw but few and found none of their burrows in a search of three weeks.

In the following notes the fact is mentioned that some of the species of *Okanagana* and *Platypedia* may also appear as broods. In the U. S. Department of Agriculture, Bureau of Entomology, Bulletin No. 71, on the Periodical Cicada, Dr. C. L. Marlatt states: "The writer recalls that in the summer of 1885 a very large species of Cicada (*C. marginata* Say) appeared in considerable numbers among the scrubby white oaks bordering a stream near Manhattan, Kans., and filled the air with its very loud and discordant vibrations; yet, although familiar with and a frequent visitor of these woods in earlier and later years, no other experience with this particular species was had. It may be, therefore, that this species, which is more than twice the size of the periodical Cicada, has an even longer life period. There are other western or Rocky Mountain species which give evidence of paralleling very closely in periodicity and number the eastern periodical Cicada."

Tibicen tigrina new species. Pl. XVII, Figs. 1 and 5.

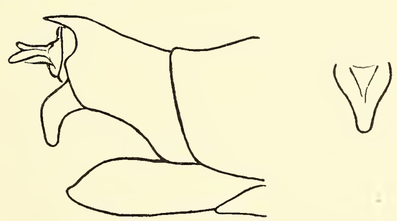
Type male from New Braunfels, Comal Co., Texas, July 11, 1926, and allotype from the same place, July, 1922 (Otto M. Locke, Jr.). Davis collection.

Resembles *Cicada montezuma* Distant, described and figured in Biologia Centrali-Americana from Mexico.

Head across eyes broader than the anterior width of the pronotum, front moderately produced with the median sulcus but faintly represented; transverse rugae well defined by the silvery hairs in the grooves. Many silvery hairs on the face and some in the depressions of the dorsal surface and on the abdominal segments. Beneath pruinose with many hairs on the legs. The short opercula meet along the inner margins and are rather evenly rounded at the extremities. The last ventral segment is rounded and feebly

notched at the extremity. Uncus bent as shown in the illustration. Sides of the body in the male parallel for a considerable distance, somewhat less so in the female. The last ventral segment of the allotype has a shallow notch with a spot each side.

General color buff and black, resembling in this respect the much larger *Tibicen rudis* of Mexico, but it differs from that species in having less pointed wings and a very differently shaped uncus. (See Bio. Centr.-Am. Homoptera, Tab. 2, Fig. 20.) Head black with six buff spots; one on the front, one just behind it, one over each antenna and one near each eye posteriorly. Pronotum greenish buff, the collar black anteriorly for about half of its width, the black extending along the sides to the anterior angles; grooves black. The mesonotum is more black than buff, with a central pale W-shaped mark about the two obconical black spots at the anterior margin. The cruciform elevation or X is pale, with a black spot centrally, and two oblong pale spots each side near the wings, the anterior one much the larger. Abdomen black above, the first segment broadly and irregularly margined with buff, and all of the other segments margined or striped posteriorly with buff usually to about one third of their area. Underside of the body straw-colored, narrowly black near the eyes, and the legs variegated with black, especially at the joints and the tarsal claws. Fore wings with a dark stripe or spot about 2 millimeters in length contained in the basal area and extending about two thirds of the way through its central part toward the base of the wing; venation pale, darker about the marginal cells; first and second cross veins clouded. The basal membranes of both pairs of wings are pale gray in color.



TIBICEN TIGRINA TYPE

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	26	28
Width of head across eyes	11	11.5
Expanse of fore wings	78	84
Greatest width of fore wing	12	13
Greatest width of operculum	5.5	
Greatest length of operculum	6	

In addition to the type and allotype there are twenty-two male and ten female paratypes in the writer's collection, all from New Braunfels and collected in July, August and September. The Cornell University expedition of 1917 collected a male at Anhalt, Comal Co., Texas, June 28, and a male and female at Juno, Texas, July 3. Dr. H. H. Knight also collected a male at Comstock, Texas, July 3, 1917. In the collection of the U. S. National Museum there are specimens from Texas as follows: Gatesville, July 16, 1888, and Kerrville, June 19, 1907 (F. C. Pratt). In this Journal for June, 1926, five males and two females doubtfully identified as *Tibicen montezuma* are recorded from Arbuckle Mountains, Oklahoma, July, 1925, collected by Mr. Raymond H. Beamer, who described the song as shrill and loud and the insect hard to locate and wild.

In the Transactions of the Maryland Academy of Sciences for 1892, p. 154, Uhler states that *montezuma* Distant occurs in Mexico, California, Arizona, New Mexico and Texas. The writer now has two males from Mexico, one from Cuernavaca, received through the kindness of Prof. Alfonso L. Herrera, that more closely resemble the figure in Bio. Centr.-Am. and are distinct from *tigrina*. One of the Mexican specimens has been compared in the British Museum by Mr. W. E. China.

Tibicen inauditus Davis.

This species resembles *tigrina,* but is much smaller and darker colored. It was described from Oldham County, Texas, and has been recorded from New Mexico. In 1926 Mr. O. C. Poling collected one female and three males in June and July at Sunny Glen Ranch, near Alpine, Brewster County, Texas. On June 7, 1927, Mr. George P. Engelhardt also collected a male at Alpine, Texas. In Cimarron County, Oklahoma, three miles north of Kenton, a female was collected by Prof. T. H. Hubbell, July 2, 1926. These specimens are in the writer's collection. Another female, in the collection of the University of Michigan, was collected at Kenton, July 6, 1926 (T. H. Hubbell).

Cacama crepitans Van Duzee.

On the 23d of July, 1924, Mr. R. P. Dow collected three males and one female of this species at San Juan Capistrano, Orange

Co., California, and on June 26, 1927, Mr. Alonzo C. Davis collected eight males at the same place. On June 18, 1927, Mr. Davis also collected a female at Newport, Calif. These localities extend northward, the recorded range for this species. On the 4th of June, 1922, Mr. Howard H. Cleaves captured by hand two males on Broncho grass near San Diego, Calif., and wrote that the song was high pitched.

Cacama carbonaria Davis. Pl. XVII, Fig. 2.

In the collection of the U. S. National Museum there is a male from Puente de Ixtla, Morelos (C. C. Deam). This place is about 150 miles south of Mexico City, the type locality. The uncus has been compared with that of the type described and figured in this JOURNAL, March, 1919. The U. S. National Museum specimen expands 70 millimeters and is here figured. It is somewhat smaller than the type, which was heretofore the only recorded specimen.

Okanagana gibbera new species. Pl. XVII, Figs. 3 and 6.

Type male and allotype female from Iron Springs, Iron Co., Utah, June 26, 1919 (T. Spalding). Davis collection.

This beautifully colored orange and black species resembles *Okanagana fratercula*, of the same region, but it is larger, with broader wings and the humped condition of the back at segments seven and eight is much more pronounced.

Head narrower than the front margin of the pronotum; front considerably produced and prominent. Median sulcus of the front well defined with the sides nearly parallel. Pronotum with the humeral angles rounded, the anterior angles prominent and the sides slightly wavy and uneven. Last ventral segment with the sides converging toward the extremity, which is shallowly notched, or in some of the paratypes almost truncate. Uncus black, and when viewed in profile with the top and lower lines nearly parallel until the extremity is approached. When viewed from behind, with a shallow notch at the extremity. The valve in the males extends slightly beyond the uncus; is pale orange, blackened beneath at the base. The last ventral segment of the allotype is deeply notched with a very slight indication of an inner notch. Fore wings broad with the costal margin bright orange almost to the end of the wings, where it is slightly darkened; basal cell opaque with surrounding vein bright orange. The venation is bright orange nearly to the row of marginal cells, where it is almost black, a noticeable feature of the species on account of the contrasting colors. The bases

of both pairs of wings, as well as the membranes, are orange margined with black or fuscous. Head black with the front at the top of the median sulcus, a spot above each antenna and a line almost connecting these spots, pale. In some of the paratypes the head is entirely black except for the spots above the antennæ. Pronotum black with the hind margin or collar and about one half of the lateral margin at the anterior angles, orange. Some of the paratypes have the anterior margin very narrowly orange. There is a central pale line extending back to the collar, absent in some of the paratypes. Mesonotum black with the posterior margin, two central spots at the anterior extremities of the elevated X, and a spot each side at the base of the hind wings, orange. Metanotum margined posteriorly with orange. Tergum black with segments 7, 8 and 9 margined posteriorly with orange. Beneath the legs are marked with orange and black with the posterior surfaces orange.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	27	25
Width of head across eyes	7	7
Expanse of fore wings	66	65
Greatest width of fore wing	12	12
Length of valve	5	

OKANAGANA GIBBERA TYPE

In addition to the type and allotype, the following specimens are in the writer's collection: Two males and fifteen females collected at the same time and place as the types, by Mr. Tom Spalding and Mr. Warren Knaus; male, Coal Creek, Iron Co., Utah, June 27, 1919 (T. Spalding); two males, Reno, Nevada, June 6, 1909 (Dr. E. D. Ball); male, Burns, Oregon, June 1, from Oregon Agricultural College. Additional specimens have

been examined as follows: Yakima City, Washington, July 2, 3, 4, 1882, female; Ft. Laramie, three females, and Bridger Basin, Wyoming, four males and a female, all in collection Museum of Comparative Zoology, Cambridge, Mass. Laramie, Wyoming, male (Dr. B. H. Grave), and White River, Colorado, August 6, 1877, male (Miss E. H. Danforth), in collection U. S. National Museum.

The very much humped back, especially in the female, together with the broad wings and bright, contrasting colors, will serve to separate this species, which was mentioned but not named, in this JOURNAL for 1919, p. 209.

Okanagana fratercula Davis. Plate XVIII, Fig. 1.

This species was described in this JOURNAL for March, 1915, from a single male taken in Iron County, Utah. Other examples are mentioned in the 1919 volume, page 209. Since that date many more have been examined from Idaho, Wyoming, Nevada and Utah, collected in May, June and July. A series of six males were collected July 3, 1925, at Cypress Hills, Alberta, by Mr. F. S. Carr, inspector of schools at that place. Dr. J. W. Sugden sent two males and two females collected June 9, 1925, at Red Canyon, near Bryce Canyon, Southern Utah. Three males have been examined in the collection of the U. S. National Museum from Blackfoot, Idaho, June 22, 1904 (E. S. G. Titus). Mr. R. W. Haegele sent through Mr. M. C. Lane, six males and eight females collected at Rogerson, Idaho, May 20, 1926, and wrote of the insects as follows: "They were collected from sage brush twenty miles west from Rogerson on a rolling plateau area that covers a large part of southwestern Idaho, and at an altitude of from 5,000 to 6,000 feet. They were collected on a cool, cloudy day and were not at all active, many being freshly emerged so that I could pick them from the sage at will. There were literally thousands of them and I picked as many as fifty from one ordinary sage bush less than four feet high and about three feet across. The ground was punctured full of holes where they had come through and the sage brush was full of empty pupal cases. They were noted from this point to about twenty-

five miles north in considerable abundance. At a somewhat later date they were noticed at different points in Southern Idaho and in the desert region of Eastern Oregon."

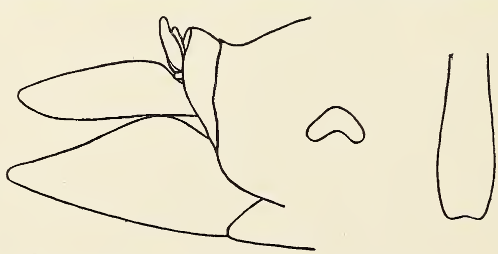
It is evident that there was a brood of this species in 1926, as described by Mr. Haegele, and if the same locality could be watched an additional life cycle to that of the seventeen-year cicada might be ascertained.

Okanagana schaefferi, O. gibbera and *O. fratercula* all inhabit Utah and resemble one another. Usually the pronotum in both *schaefferi* and *fratercula* is bordered all around with pale, whereas in *gibbera* the orange border is broken at or near the hind angles. In *schaefferi* and *fratercula* the hind margin of each abdominal segment is usually some shade of red, while in *gibbera* only the three last segments are margined with orange. The front of the small head is very prominent in *schaefferi* and *gibbera;* in *fratercula* it is less so.

In order to facilitate more ready comparison the original figures of *schaefferi* and *fratercula* from this JOURNAL of March, 1915, are reproduced on the accompanying plate. *Okanagana fratercula* may be larger than the figure and attain an expanse of wings of sixty millimeters.

Okanagana opacipennis Davis. Pl. XVIII, Fig. 2.

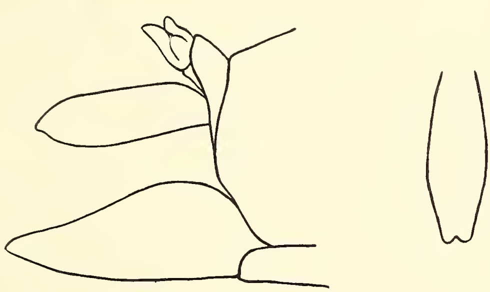
This insect was described and figured in the June, 1926, number of this JOURNAL, from a female taken at Buckman Springs, San Diego Co., California, June 23, 1925 (Prof. W. S. Wright), as a variety of *Okanagana arctostaphylæ* Van Duzee. Prof. Wright on June 26, 1926, collected a male *opacipennis* at the same locality, and as in the first instance on manzanita. A figure



OKANAGANA OPACIPENNIS DAVIS

of the uncus is here presented; also one of the uncus of *arctostaphylæ*. The differences thus shown, taken together with color differences, would indicate that *opacipennis* should be considered as distinct from *arctostaphylæ*.

The male of *opacipennis* is like the female type except that it is not quite so brilliantly colored. The red on the head and pronotum has a greenish tinge, as have the veins of both pair of wings. The abdomen is black dorsally, except the last two segments, which are pale, the penultimate one having a dorsal black spot. In the type, the under side of the abdomen is red, each segment having a black spot on each side, leaving the central part of the abdomen an even color, except for the basal black spot on segment one found in many *Okanagana*. Legs in both the male and female entirely red in color, narrowly blackened at the joints. The uncus and valve are shaped as figured. The former has a pale dorsal stripe, blackened at the sides; the latter is entirely pale green. The under side of the abdomen in the male is pale, in part greenish, especially near the end, while the usual black spot is at the base of the first segment. The measurements in millimeters are as follows: Length of body, 26; width of head across eyes, 7; expanse of fore wings, 65; greatest width of fore wing, 10; length of valve, 4.



OKANAGANA ARCTOSTAPHYLAE VANDUZEE

Tibicinoides minuta Davis. Plate XVIII, Fig. 6.

Numerous examples of this very small-headed species, with the marginal areas to the wings shorter than in *Okanagana*, have been examined since it was described in this JOURNAL for March, 1915. Mr. F. E. Winters has collected many on a hillside within

the city limits of Santa Barbara, Calif., some of them on tarweed. Thirty-four specimens were found in April, May and June, the majority in May, 1926, when they were quite common. While in most the color at the base of the wings is bright orange, it is more red in a few examples. Other specimens are as follows: Coalinga, Fresno Co., Calif., June, 1907, three males (Prof. Bradley), collection Cornell University; Mt. Hamilton, Santa Clara Co., June 20, 1922, three males (F. H. Wymore); Lebec, Kern Co., Calif., June 1, 1918, three males (A. C. Davis), and Ft. Tejon, Calif., May 29, 1927, two males (A. C. Davis).

The original figures of the types of *Tibicinoides minuta* and the closely allied *Tibicinoides mercedita*, from this JOURNAL of March, 1915, are here reproduced for comparison.

Clidophleps vagans Davis. Pl. XVIII, Fig. 3.

The specimen figured was received for examination from the British Museum through the courtesy of Mr. W. E. China and is the second example known. It is a male and labeled Yosemite, Tioga Pass, July 17, 1922 (C. B. Pearson). The type described and figured in this JOURNAL, March, 1925, was found in an automobile after an extended journey, so the exact locality could not be given.

Clidophleps tenuis new species. Pl. XVIII, Fig. 4.

Type male from La Puerta Valley, San Diego Co., California, May 29, 1927, and allotype collected at the same time and place by Mr. J. C. von Bloeker.

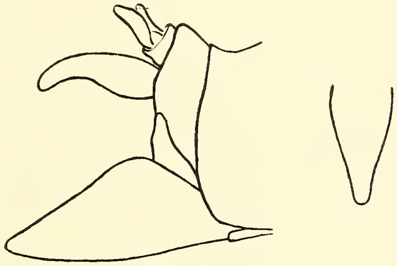
Head as broad as the front margin of the pronotum; front produced about as in *blaisdelli* and *pallida*. Median sulcus of the front shallow, sides not parallel and broadest near its central portion. In the allotype the sides of the groove are more nearly parallel. Pronotum with humeral angles rounded; the anterior angles prominent. Last ventral segment somewhat constricted at the sides near the central portion and the extremity but slightly truncate. Uncus when viewed in profile bent downward at the extremity and sinuate on the lower part of the apical half; slightly shorter than the valve, but more nearly its length than in any *Clidophleps* with the exception of *vagans*. Last ventral segment of the allotype broadly and doubly notched. Basal cell of the fore wings clear. Costal margin of the fore wings black; subcostal vein greenish; radial vein black; remaining veins almost entirely black; anal vein and part of the attenuated nodus

pale. Membranes at base of all of the wings pale salmon color and not quite so dark as in *pallida*.

General body color black, variegated with greenish yellow. Head shining black, a pale spot above each antenna, and three spots at the back of the head behind the ocelli, the central one being the largest. Beneath, the head is black, pale each side of the transverse rugæ; the median sulcus is centrally black, the edges paler. Pronotum with a large rufus area margined with black on each side of the pale central line, which line extends back to the posterior margin of the collar, also pale in color. Mesonotum black, margined at the sides and posteriorly with pale. Two pale J-shaped marks, placed centrally and rather close together, extending backward toward the elevated X, which is pale at its central portion, with the fore limbs crossed by black, and then two pale torch-like marks extending toward the anterior margin. The last mentioned marks are more attenuated than the similar ones in *pallida, distanti* or *blaisdelli,* and more closely resemble those of *astigma*. Metanotum pale with a curved black spot near the base of each wing. Dorsum of the abdomen shining black, each segment margined posteriorly with greenish yellow. The uncus black above, slightly pale toward the extremity, and the valve pale. The abdomen is pale beneath; the legs pale with the femora, tibæ and tarsi black on the outer surfaces.

MEASUREMENTS IN MILLIMETERS

	Male Type	Female Allotype
Length of body	26.5	23
Width of head across eyes	8	7
Expanse of fore wings	64	64
Greatest width of fore wings	10	10
Length of valve	4	



CLIDOPHLEPS TENUIS TYPE

In addition to the type and allotype Mr. von Bloeker collected three males and four females at the same place and time, describing the conditions as desert in character.

This species resembles *Clidophleps pallida,* but the fore wings are narrower and lie flatter; that is, are not so much bulged up centrally when they are expanded. In these respects it approaches *C. vagans,* but differs from it in having the nodus at the outer end of the cubital cell much broader and the cubitus vein more arched, as will be seen by comparing the figures presented. In *C. tenuis* the J-shaped marks on the mesonotum are more parallel than in the other known species of the genus. *Clidophleps astigma* figured in this JOURNAL for March, 1917, has the front of the head broad and prominent. Figure one of the same plate is there identified as *C. blaisdelli* Uhler, but in 1926 this form was described as *C. wrighti,* after Uhler's types in the U. S. National Museum had been examined.

Platypedia putnami Uhler.

The typical form of this species has been recorded from Colorado, Nebraska, Nevada, New Mexico and California, but its known distribution may be extended to Arizona. Mr. D. K. Duncan has sent a male and three females collected at Diamond Creek, White Mountains, June 6, 1925, and Mr. George P. Engelhardt has given me a male collected in the Sierra Ancha Mountains, June 15, 1927. Variety *lutea,* with the colors orange and black instead of red and black, seems to be more common in Arizona.

Platypedia barbata Davis.

Santa Barbara, Calif., May, 1926, male (F. E. Winters). The male type and female allotype were from San Louis Obispo, California, and were collected in April. The male from Mr. Winters is the only additional specimen so far recorded. Santa Barbara is about eighty miles southeast of the type locality and in the adjoining county.

Neoplatypedia ampliata Van Duzee.

In the collection of the British Museum there is a male labeled "*C. californica* Fitch Ms. California." This manuscript name has of course no standing. The specimen has the uncus turned

upward at the extremity, which is not constricted, but is as figured in this JOURNAL, June, 1920, and the membranes at the base of both fore and hind wings are almost white instead of orange, as in *constricta.*

Neoplatypedia constricta Davis.

This species was reported from Arizona, Utah, Colorado, and California when originally described. To this distribution may now be added Pocatello, Idaho, May 23, 1889, two males and a female, collection Iowa State College of Agriculture, and Bliss, Twin Falls Co., Idaho, May 25, 1927, five males and two females (R. W. Haegele). Mr. Haegele noted that they were "collected from sage in desert and were rather numerous."

Melampsalta kansa Davis.

In the collection of the U. S. National Museum there are Texas specimens of this species from a number of localities, among them a female labeled "Cuero, Tex., 5–3–96, Marlatt," and also "Insect Book, Pl. 28, Fig. 8," where it is identified as *Melampsalta parvula.*

PLATE XVII

FIG. 1. *Tibicen tigrina.* Type.
FIG. 2. *Cacama carbonaria.*
FIG. 3. *Okanagana gibbera.* Type.
FIG. 4. *Okanagana schaefferi.* Type figure reproduced.
FIG. 5. *Tibicen tigrina.* Showing opercula.
FIG. 6. *Okanagana gibbera.* Showing back of female.

CICADIDÆ

PLATE XVIII

FIG. 1. *Okanagana fratercula.* Type figure reproduced.
FIG. 2. *Okanagana opacipennis.*
FIG. 3. *Clidophleps vagans.*
FIG. 4. *Clidophleps tenuis.* Type.
FIG. 5. *Tibicinoides mercedita.* Type figure reproduced.
FIG. 6. *Tibicinoides minuta.* Type figure reproduced.

CICADIDÆ

THE MEMBRACIDAE OF SOUTH AMERICA AND THE ANTILLES, II. SUBFAMILY CENTROTINAE

By FREDERIC W. GODING

Tribe Acuminatini

Genus **ETONEUS**

Kirkaldy, Entom. xxxvii, p. 279 (Nom. nov); *Anomus*, Fairm. Rev. Memb. p. 521.

KEY TO SPECIES

1 (2). Pronotum unarmed, yellow testaceous, apex brown; tegmina darker .... *reticulatus.*

2 (1). Pronotum with a short acute suprahumeral horn each side, yellow testaceous, horns fuscous behind; tegmina opaque gray, subsilky; below body, and femora blackish...................... *cornutulus.*

LIST OF SPECIES

reticulatus Fairm. l. c., p. 522, pl. 7, f. 31–32. Braz.
cornutulus Stal, l. c., p. 34. Rio J. Braz.

Genus **EUWALKERIA**

Goding, Tr. Am. Ent. Soc. lii, p. 104.

KEY TO SPECIES

One pale ferruginous species with gilded pubescence; pronotum with four dorsal protuberances, a slight median carina, the disk, abdomen and femora, testaceous; tibiæ broadened almost foliaceous, testaceous with black markings; tegmina almost hyaline, base and veins testaceous .... *latipes.*

LIST OF SPECIES

latipes Walk. List Hom. p. 649. Colombia.

Possibly *Tylocentrus quadricornis* Funkh. from Arizona, belongs to this genus.

Genus **LIRANIA**

Stal, Hem. Rio J. ii, p. 36.

KEY TO SPECIES

One fusco-ferruginous species, legs paler; tegmina yellowish, base darker, punctate .... *bituberculata.*

LIST OF SPECIES

bituberculata Stal, l. c., p. 36. Rio J. Braz.

Genus FLEXOCENTRUS

Goding, l. c., p. 106.

Key to Species

One ferruginous densely pubescent species; pronotum punctured, median carina extended from between suprahumerals to apex, posterior process slightly longer than abdomen, dorsum sinuate; scutellum broad as long, apex bidenticulate .... *felinus.*

List of Species

felinus Haviland, Zool. vi, p. 255, pl. 6, f. 6. Kartabo, Brit. Guiana.

Genus ŒDA

Amyot & Serville, Hem. p. 546.

Key to Species

1 (2). Front of pronotum armed superiorly with two small porrect horns .... *hamulata.*
2 (1). Front of pronotum unarmed.
3 (4). Metopidium vertical, front margin sinuate, basal margin produced over head, posterior median line nearly vertical, apex spined .... *informis.*
4 (3). Metopidium strongly inclined forward, basal margin not produced over head; dorsum of pronotum convexly decreasing in altitude posteriorly .... *inflata.*

List of Species

hamulata Stal, Hem. Fabr. ii, p. 52; *inflata* Fairm. l. c., p. 506, pl. 3, f. 1; Walk. l. c., pl. 4, f. 9; Buckt. Mon. pl. 45, f. 4. Braz.

informis Westw. An. Nat. Hist. (1842), p. 119, pl. 6; Fairm. l. c., p. 506, pl. 6, f. 28; Buckt. l. c., pl. 45, f. 3. Braz.

inflata Fabr. Mant. Ins. ii, p. 262; Ent. Syst. iv, p. 8; Syst. Rh. p. 6; Perty, Del. An. Ins. p. 178, pl. 35, f. 8; *inermis* Fairm. l. c., p. 506; *frondosa* Buckt. l. c., p. 206, pl. 45, f. 5. Cayenne, D. Guiana; Braz.

Genus LYCODERES

Germar, Rev. Ent. Silb. iii, p. 259.

Key to Species

1 (18). Front pronotal process emitting posteriorly a falcate protuberance from or near summit distant from scutellum.
2 (15.) Tegmina vitreous in decolored in part, bases and apical margins fuscous or black.
3 (10). Summit of front process concave between bases of apical lobes.
4 (7). Apical lobes strongly diverging, nearly horizontal.
5 (6). 2d apical cell of corium triangular .... *fuscus.*
6 (5). 2d apical cell of corium irregularly quadrangular.............. *lobatus.*

7 (4). Apical lobes of front pronotal process more or less parallel; 2d apical cell of corium irregularly quadrangular.
8 (9). Superior hind protuberance of pronotum falcate; tips apical lobes of front process acute, slightly diverging....................*gaffa.*
9 (8). Superior hind process straight; apical lobes twisted together their tips obtuse nearly truncate ....*igniventer.*
10 (3). Summit of front pronotal process not concave.
11 (12). Apex of front pronotal process expanded in a broad trapezoid, tip each side acute ....*galeritus.*
12 (11). Apex of front pronotal process flat or elevated in a short protuberance, lobes divaricate; 2d apical cell of corium irregularly quadranglar; wings with 4 apical cells 2d stylate.
13 (14). Summit of front pronotal process flat................(♂) *hippocampus.*
14 (13). Summit of front pronotal process produced above origin of posterior sinuate extension ....(♀) *hippocampus.*
15 (2). Tegmina wholly ferruginous or sordid yellow, pellucid, base opaque, apical margin concolorous.
16 (17). Apical lobes of pronotal process short, subhorizontally divaricate; pronotum usually destitute of yellow markings............*gladiator.*
17 (16). Apical lobes of pronotal process longer, slightly diverging and curved outward; a vertical median stripe on metopidium and band near base of posterior falcate process yellow (sometimes obsolete) ....*latipennis.*
18 (1). Front pronotal process destitute of a sinuate protuberance behind bases of apical lobes, pronotum gradually passing into posterior process which is close to scutellum.
19 (24). Summit of front pronotal process slightly dilated or very weakly notched, not bilobed.
20 (23). Summit of front pronotal process seen from front slightly dilated, not notched; posterior process gradually acuminate not slender.
21 (22). Front pronotal process seen from side gradually passing from broad rounded summit to posterior apex ....*capitata.*
22 (21). Front pronotal process seen from side produced in an obliquely ascending horn its sides parallel, gradually passing from its base to posterior apex ....*minamen.*
23 (20). Summit of front pronotal process seen from front slightly notched, posterior process long, slender............................*petasus.*
24 (19). Summit of front pronotal process distinctly notched.
25 (30). Apical lobes of front process paralled, contiguous, extreme tips very slightly diverging, much longer than broad.
26 (29). Front pronotal process porrect, apical lobes obtuse and almost truncate at tips, posterior process not sinuate above scutellum; corium with a triangular vitreous spot.
27 (28). Dorsum of pronotum seen from side straight or very slightly sinuate ....*burmeisteri.*

28 (27). Dorsum of pronotum seen from side forming an almost right angle posteriorly ....*unicolor.*

29 (26). Front pronotal process almost erect, posterior process lightly sinuate above scutellum ....*prolixus.*

30 (25). Apical lobes of front pronotal process distinctly diverging, almost horizontal.

31 (34). Front horn of pronotum porrect, sides rugose, apical lobes very small; scutellum covered.

32 (33). Dorsum of posterior pronotal process convexly rounded to apex, pronotum unicolorous brown, strongly punctured, summit of front horn elevated, sides rugose, short; tegmina dark, opaque, bases punctate, apices rounded....................................*phasianus.*

33 (32). Dorsum of posterior pronotal process lightly concave, nearly straight, pronotum laterally rugose and tricarinate, testaceous, punctured, front horn long, lightly deflexed, sides sparingly serrate; tegmina hyaline brown, opaque, bases punctate, apices obliquely truncate and irrorate with ferruginous dots. *serraticornis.*

34 (31). Front pronotal horn nearly erect, apical lobes medium in size, if small the summit is broadly rounded.

35 (36). Summit of front pronotal horn broadly expanded hemispherically, convex above, a small spine each side; corium with a triangular vitreous spot ....*mitratus.*

36 (35). Summit of front pronotal horn produced in 2 large diverging lobes, flat above, half longer than breadth at base.

37 (38). Tegmina entirely ferruginous, basal third strongly punctate, 2d apical cell of corium triangular ....*emarginatus.*

38 (37). Tegmina with a triangular vitreous spot.............................*pileolus.*

LIST OF SPECIES

fuscus A. & S. Hem. p. 552, pl. 12, f. 10; Fairm. Rev. Memb. p. 524, pl. 3, f. 24. *furca* Fairm. l. c., p. 524; Buckt. l. c., pl. 44, f. 4. Rio J., Bahia, Braz.

lobatus Stal, Hem. Rio J. ii, p. 34, *wahlbergi* Stal, l. c., p. 35; *angustata* Buckt. l. c., p. 201, pl. 44, f. 3; *torta* Buckt. l. c., p. 202, pl. 44, f. 6. Tejuca, Rio J. Braz.

gaffa Fairm. l. c., p. 524, pl. 3, f. 29, 30 and 31. Braz.

igniventer Buckt. l. c., p. 200, pl. 44, f. 1. Braz.

galeritus Less. Ills. Zool. pl. 56, f. 1, a, b, c. Rio J., Braz.

hippocampus Fabr. (♂) Syst. Rh. p. 20; *ancora* Germ. (♀) Mag. Ent. iv, p. 32, pl. 1, f. 3; Fairm. l. c., pl. 3, f. 27; Buckt. l. c., pl. 47, f. 4. Braz; Pelileo, Baños, Ecuad; Kartabo, B. Guiana. (Note: Dr. F. X. Williams presented a pair in coitu to me, taken at Baños.)

gladiator Germ. Rev. Ent. Silb. iii, p. 310; Fairm. l. c., pl. 3, f. 26; *bellicosa* Walk. List Suppl. p. 165; *truncatulus* Stal, Hem. Rio J. Braz. ii, p. 36; *fuscata* Buckt. l. c., p. 204. Braz.

latipennis Walk. List p. 607; *corniger* Stal, l. c., p. 36. Rio J. Braz.
capitata Buckt. l. c., p. 203, pl. 43, f. 8, and pl. 44, f. 7. Hab: ? S. Am.
minamen Buckt. l. c., p. 51, pl. 6, f. 7. Cachabe, Ecuad.
petasus Fairm. l. c., p. 525; *laeta* Walk. List p. 494. Braz.
burmeisteri Fairm. l. c., p. 525, pl. 3, f. 28; Buckt. l. c., pl. 44, f. 2; *fissa* Walk. List p. 485; *triangulata* Funkh. Jour. N. Y. Ent. Soc. xxvii, p. 276. Rio J., San Paulo, Braz.
unicolor Fairm. l. c., p. 525. Braz.
prolixus Stal, Hem. Rio J. ii, p. 35; *luctans* Stal, l. c., p. 35. Rio J. Braz.
phasianus Fowl. Biol. C. A. Hom. ii, p. 164, pl. 10, f. 9. Pan.
serraticornis Fowl. l. c., p. 165, pl. 10, f. 10; Buckt. l. c., pl. 45, f. 2. Pan; Braz; Mira, Ecuad; New Amsterdam, B. Guiana.
mitratus Germ. Rev. Ent. Silb. iii, p. 311; Fairm. l. c., pl. 3, f. 25; Walk. l. c., p. 632; Buckt. l. c., pl. 44, f. 5; *spinolae* Fairm. l. c., Rev. Zool. (1846), p. 12. Braz.
emarginatus Fabr. Syst. Rh. p. 14; *flexuosa* Fabr. l. c., Index p. 53. Braz.
pileolum Fairm. l. c., p. 520. Rio J. Braz; Cayenne, D. Guiana.

Genus STEGASPIS

Germar, Rev. Ent. Silb. iii, p. 231.

KEY TO SPECIES

1 (10). Tegmina hyaline or with a large vitreous spot.
2 (7). Front of pronotum suddenly compresso-elevated forming an acute angle with dorsum, gradually acuminate to apex; ground color green or yellowish green.
3 (4). Dorsum straight, no lateral raised lines, densely punctured; 4th apical cell of corium quadrangular narrowed towards truncate base .... *bracteata*.
4 (3). Dorsum very convex, with 3 lateral carinæ; finely punctate.
5 (6). Tegmina punctate on basal third extended for two-thirds of fore border, 4th apical cell of corium quadrangular, transverse, terminal, with 5th cell occupying posterior margin....*laevipennis*.
6 (5). Tegmina entirely hyaline, base only punctate, 4th apical cell of corium not quadrangular, narrowed towards base, 3d cell terminal, 3d, 4th and 5th cells occupying posterior margin; pronotum green or yellow .... *viridis*.
7 (2). Front of pronotum elevated in a horn or process, dorsum straight or slightly concave; 3d apical cell of corium terminal; ground color ferruginous.
8 (9). Front pronotal horn nearly erect, compressed, short, summit obtuse; tegmina subopaque black with a large triangular vitreous area exteriorly, basal fourth punctate.......................... *aperta*.
9 (8). Front pronotal horn obliquely ascending, conical, much longer than breadth of head, 3 slight elevated lines each side; tegmina

broadly punctate along costal two-thirds from base and basal third of interior border, otherwise hyaline........................*insolita.*

10 (1). Tegmina entirely opaque, destitute of vitreous spot.

11 (12). Front of pronotum elevated in an erect horn or process, its summit truncate, dorsum distinctly bisinuate; ground color yellow and brown clouded ....*fronditia.*

12 (11). Front of pronotum suddenly compresso-elevated forming an angle with dorsum, gradually acuminate behind angle; ground color brown to black.

13 (14). Dorsum rounded anteriorly, nearly straight superiorly, its altitude equal to that of the strongly rounded apex, basal third of pronotum punctured, ferruginous with pale margin anteriorly; tegmina concolorous, distinctly and densely punctate.....*folium.*

14 (13). Front of pronotum vertical, forming near summit a short obtuse angle forward, dorsum triundulate, pronotum piceous, punctured, with 2 or 3 raised lines each side; tegmina concolorous with numerous ferruginous dots ....*galeata.*

List of Species

bracteata Fabr. Mant. Ins. ii, p. 263; Ent. Syst. iv, p. 10; Syst. Rh. p. 10; Stal, Hem. Fabr. ii, p. 54. Para, Rio J., Braz., Cayenne, D. Guiana.

laevipennis Fairm. l. c., p. 527. *marginalis* Walk. List p. 479, pl. 4, f. 7. Cayenne, D. Guiana; Para, Braz; Kartabo, B. Guiana.

viridis Funkh. Bul. Brook. Ent. Soc. x, p. 104, pl. 2, ff. 1–5. Trinidad, W. I.

aperta Walk. List Suppl. p. 337. Rio J. Braz.

insolita Walk. Ins. Saund. Hom. p. 109. S. Am.

fronditia Deg. Ins. iii, p. 208, pl. 32, ff. 15–16; Stoll, Linn. Syst. Nat. ii, p. 705; Cic. p. 36, pl. 6, f. 31; *gibberifolia* Stoll, l. c., p. 69, pl. 17, f. 93; *insignis* Buckt. l. c., p. 59, pl. 8, f. 6. Cayenne and Surinam, D. Guiana; Amazons, Parintius and Prata, Braz; Iquitos, Peru; New Amsterdam and Blairmont, B. Guiana.

folium Stoll, l. c., p. 46, pl. 10, f. 48; *melanopetala* Stoll, l. c., p. 62, pl. 15, f. 80; *abdominalis* Fabr. Syst. Rh. p. 10; *galeata* Havil. Zool. vi, p. 258, pl. 4, f. 7. Surinam, D. Guiana; Tena, Ecuad; Kartabo, B. Guiana.

galeata Walk. List p. 486; Suppl. p. 341; *truncatulis* Buckt. l. c., p. 203, pl. 45, f. 1. Para, Braz.

Genus **MELIZODERES**

Blanchard, Hist. Fis. y Polit. Chile, Gay, vii, p. 266; *Methille* Butler, Proc. Zool. Soc. Lond. (1881), p. 86; *Glischrocentrus* Fowler, Biol. C. A. Hom. ii, p. 161.

Key to Species

1 (2). Dorsum of pronotum strongly arcuate, uniformly convex, strong median carina, compressed at middle and elevated into a crest,

posterior process very short; tegmina extended one-half their length behind apex of abdomen ....*gayi.*

2 (1). Dorsum of pronotum strongly elevated anteriorly, moderately produced conically forward above the head, not rounded and convex, tegmina passing apex of abdomen by less than one-half their length.

3 (6). Posterior pronotal process reduced to a small pointed projection; dorsum of scutellum lightly convex at base.

4 (5). Summit of metopidium angulate; color testaceous, tegmina testaceous hyaline, slightly longer than abdomen........................*carinatus*

5 (4). Summit of metopidium obtusely rounded, not angulate; color uniform yellow, tegmina with a transverse hyaline band, but slightly longer than abdomen...*dohrnii*

6 (3). Posterior pronotal process slender, half as long as abdomen; scutellum flat; color testaceous, tegmina concolorous much longer than abdomen ....*cucullatus.*

List of Species

gayi Blanchard, l. c., p. 268, pl. 3, f. 5; Godg. Rev. Chile, Hist. Nat. xxvii, p. 118 and 122. Many localities in Chile.

carinatus Blanch. l c., p. 269; Godg. l. c., p. 118 and 122; *cuneata* Butl. l. c., p. 87. Many localities in Chile.

dohrni Sign. An. Soc. Ent. Fr. ser. 4, iii, p. 584, pl. II, f. 9. Chile.

cucullatus Fowl. l. c., p. 161, pl. 10, f. 5. Volcan de Chiriqui, Pan.

Genus **CENTRUCHOIDES**

Fowler, l. c., p. 161.

Key to Species

One species easily recognized by the large broad suprahumerals which are usually dentate or sinuate on exterior margins at middle, and 3 discoidal cells in the corium ....*perdita.*

List of Species

perdita A. & S. Hem. p. 577, pl. 11, f. 5; *laticornis* Fowl. l. c., p. 162, pl. 10, f. 6. North America; Bugaba, Pan.

Genus **BOCYDIUM**

Latreille, Cuv. Reg. An. King. iii, p. 366; *Sphœronotus*, Laporte, An. Soc. Ent. Fr. i, p. 139.

Key to Species

1 (4). Pronotum entirely black, immaculate.

2 (3). Body below and head black ....*globulifera.*

3 (2). Body below red or yellow; head black, orbits of eyes yellow; tegmina hyaline ....*globulare.*

4 (1). Pronotum black with white stripes anteriorly.

5 (6). Pronotal nodes reddish, opaque, with long hairs, front nodes one-half the size of the others; head with 2 white vittae; abdomen

and legs yellow; tegmina hyaline, base and nebulose fascia at tips brown ....*rufiglobum.*

6 (5). Pronotal nodes black; scutellum white punctate.

7 (8). Nodes of pronotum small, front nodes minute, opaque, the other nodes very minute, barely evident; head variegated with white. *germari.*

8 (7). Nodes of pronotum equal, black; shining; chest, abdomen and legs yellow; tegmina fusco-fasciate; head with 2 white stripes. *tintinnabuliferum.*

LIST OF SPECIES

globulifera Pallas, Spic. Zool. fasc. 9, p. 22, pl. 1, f. 12; Stoll, Cig. p. 112; Fairm. Rev. Memb. p. 508. Cayenne, D. Guiana.

globulare Stoll, l. c., p. 110, pl. 26, f. 163; Fabr. Syst. Rh. p. 129; Kirby, Mag. N. H. (1829), p. 21, f. 6a. Westw. An. King. Cuv. p. 569, f. 100a; in Dunc. Nat. Lib. i, p. 286, pl. 25, f. 1; Fairm. l. c., p. 508, pl. 3, f. 4; Walk. List, pl. 4, f. 15; Buckt. l. c., p. 209, pl. 45, f. 8, and pl. 46, f. 1. Braz; Surinam, D. Guiana; Kartabo, B. Guiana; Baños, Ecuad.

rufiglobum Fairm. l. c., p. 508; Buckt. Mon. p. 208, pl. 45, f. 7. Braz.

germari Guer. l. c., Reg. An. Ins. iii, p. 366; Fairm. l. c., p. 509. Braz.

tintinnabuliferum Less. Ills. Zool. pl. 55, f. 1; Buckt. l. c., pl. 45, f. 6; *glomeriferum* Germ. Rev. Ent. Silb. iii, p. 260; Fairm. l. c., p. 508; Buckt. l. c., pl. 45, f. 8. Rio J. Braz.

Genus **STYLOCENTRUS**

Stal, Hem. Fabr. ii, p. 49.

KEY TO SPECIES

1 (2). Humerals of pronotum produced in spines; tegmina with basal cells opaque ....*ancora.*

2 (1). Humerals of pronotum not produced in spines; tegmina hyaline, clavus and exterior part of corium punctate, veins strong, black ....*championi.*

LIST OF SPECIES

ancora Perty, Del. An. Ins. p. 179, pl. 35, f. 15; Buckt. l. c., p. 209, pl. 46, f. 2; *trispinosum* Guer. l. c., p. 367. Minas, Braz; Cayenne, D. Guiana; Bugaba, Pan.

championi Fowl. l. c., p. 164, pl. 10, f. 8. Bugaba, Pan.

Genus **SMERDALEA**

Fowler, l. c., p. 162.

KEY TO SPECIES

One species, brown fuscous and testaceous variegated, remotely punctured, tuberculate in front and on suprahumerals, apical spine ringed with testaceous; tegmina basal half variegated, apical half fuscous-brown. *horrescens.*

LIST OF SPECIES

horrescens Fowl. l. c., p. 162, pl. 10, f. 7; Buckt. l. c., pl. 55, f. 5. Bugaba, Pan.

Tribe *Hebesini*

Genus **NESSORHINUS**

Amyot & Serville, Hem. p. 542.

KEY TO SPECIES

1 (4). Dorsum of pronotum elevated behind humerals in a compressed process, humerals auricularly produced, posterior process unicarinate, front process narrowed forward, dorsal elevation bicarinate.

2 (3). Dorsal process of pronotum about as high as long at base, slightly narrowed from base, summit truncate, both margins straight; body more robust ....*vulpes.*

3 (2). Dorsal process of pronotum about 3 times higher than basal length, front margin curved backward towards subacute summit, hind margin vertical; body slender ....*gracilis.*

4 (1). Dorsum of pronotum destitute of an elevated process behind humerals, posterior process tricarinate and slightly gibbous, humerals not produced ....*gibberulus.*

LIST OF SPECIES

vulpes A. & S. Hem. p. 542, pl. 12, f. 11; Stal, Bid. Memb. K. p. 294; Buckt. l. c., pl. 29, f. 5. Rep. Dom; Port-au-Prince, Haiti.

gracilis M. & B. Bul. Brook. Ent. Soc. xx, p. 208, pl. 1, f. 2 and 3. Camaguey, Cuba W. I.

gibberulus Stal, l. c., p. 294. Porto Rico, W. I.

Genus **GONIOLOMUS**

Stal, Hem. Fabr. ii, p. 48; Bid. Memb. K. p. 294.

KEY TO SPECIES

One fusco-ferruginous species, abdomen and legs paler; tegmina yellowish, fuscous margined, base punctate ....*tricorniger.*

LIST OF SPECIES

tricorniger Stal, Bid. Memb. K. p. 294; Met. & Brun. l. c., p. 207, pl. 1, f. 21 and 22. Camaguey, Cuba.

Genus **ISCHNOCENTRUS**

Stal, Bid. Memb. K. p. 292.

KEY TO SPECIES

1 (4). Tegmina hyaline, immaculate, veins yellow.

2 (3). Posterior pronotal process nearly straight, longer than scutellum; not pubescent ....*inconspicuous.*

3 (2). Posterior pronotal process curved, long as scutellum; head, pronotum and tegmina golden pubescent ....*retrospinus.*

4 (1). Tegmina hyaline, basal half black or black-maculate, apical half clear with one or two black fasciae; posterior pronotal process slightly longer than scutellum, lightly curved; body not pubescent ....*niger.*

LIST OF SPECIES

niger (♂), Stal, Bid. Memb. K. p. 293; Fowl. l. c., pl. 9, f. 19; Buckt. l. c., pl. 59, f. 4; *ferruginosa* (♀), Stal, l. c., p. 293. Bogota, Colomb; Pan; Ecuad; Kartabo, B. Guiana.

retrospinus Leth. An. Soc. Ent. Fr. (1890), p. 155. Tovar, Venez.

inconspicuous Buckt. l. c., p. 255, pl. 59, f. 2. Cachabe, Ecuad.

Genus **CAMPYLOCENTRUS**

Stal, Bid. Memb. K. p. 289; *Gnamptocentrus* Fowl. l. c., p. 151; *Sphærocentrus* Fowl. l. c., p. 154.

KEY TO SPECIES

1 (7). Pronotum with suprahumerals long, strong, broad, posterior process entirely slender.

2 (5). Suprahumerals broad almost to tips which are acutely conical, carinate on inner side.

3 (4). Suprahumerals obliquely ascending, curved backward, posterior process slightly shorter than abdomen............................*hamifer.*

4 (3). Suprahumerals almost horizontal, slightly inclined backward, very broad, posterior process slightly longer than abdomen. *gibbicornis.*

5 (2). Suprahumerals broad at bases, cultrate, obliquely ascending, lightly reflexed, acuminate to tips, posterior process much longer than abdomen ....*cavipennis.*

6 (1). Pronotum with suprahumerals short, sometimes obsolete, acuminate from base, almost horizontal.

7 (10). Posterior pronotal process broad at base, acuminate to apex.

8 (9). Smaller; brownish-black; posterior pronotal process about as long as abdomen; tegmina hyaline, veins red................*aculeolus.*

9 (8). Larger; piceous mingled with yellow; posterior process much longer than abdomen, impressed each side with a yellow spot; head below, chest and abdomen yellow; tegmina lurid hyaline, base and along costa piceous ....*costalis.*

10 (7). Posterior pronotal process slender from base to apex.

11 (12). Lateral margins of posterior process sinuate, process slightly dilated at sides near middle, long as abdomen; tegmina fuscohyaline, base and along costa fuscous ....*brevicornis.*

12 (11). Lateral margins of posterior process percurrently parallel, straight.

13 (14). Discoidal cells of corium elongate ....*curvidens.*

14 (13). Interior discoidal cell of corium nearly circular, several times larger than the very small elongate exterior cell............*sinuatus.*

LIST OF SPECIES

hamifer Fairm. l. c., p. 512; Buckt. l. c., pl. 55, f. 6 and 7; *niveiplaga* Walk. List Suppl. p. 160. Mex; C. A; Pan; Yaguachi, Ecuad.
gibbicornis Walk. Ins. Saund. Hom. p. 76; Fowl. l. c., p. 150. Mex; S. A; Bocas del toro, Pan.
cavipennis Fowl. l. c., p. 153, pl. 9, f. 15. Guat; Pan.
aculeolus Fairm. l. c., p. 512. Surinam, D. Guiana.
costalis Walk. List p. 615. Colomb.
brevicornis Fowl. l. c., p. 151, pl. 9, f. 13. Guat; Pan.
curvidens Fairm. l. c., p. 515; Buckt. l. c., pl. 56, f. 4 and 5; *subspinosus* Fairm. l. c., p. 519. Mex; C. A; Ecuador; Pan.
sinuatus Fowl. l. c., p. 152. Mex; C. A; Pan.

Genus OPHICENTRUS

Fowler, l. c., p. 156.

KEY TO SPECIES

One fuscous-black species, metopidium with two bands each side converging on it, prominent humerals, ferruginous, posterior process tricarinate; tegmina fuscous, a large basal spot, one on interior margin, and apices, hyaline ....*notandus.*

LIST OF SPECIES

notandus Fowl. l. c., p. 156, pl. 9, f. 20. Volcan de Chiriqui, Pan.

Genus CENTRICULUS

Fowler, l. c., p. 157.

KEY TO SPECIES

One rufo-testaceous species, with a smooth pale testaceous median line, the very short posterior process slightly dilated towards apex; tegmina testaceous, opaque, a central hyaline spot ....*rufotestaceus.*

LIST OF SPECIES

rufotestaceus Fowl. l. c., p. 157, pl. 9, f. 22. Mex; Pan.

Genus BRACHYBELUS

Stal, Hem. Fabr. ii, p. 48; Bid. Memb. K. p. 292.

KEY TO SPECIES

One black, sparingly golden pubescent species; tegmina lurid, basal third black, punctate, apices clear, veins and obsolete fascia behind apex of clavus fuscus ....*cruralis.*

LIST OF SPECIES

cruralis Stal, Bid. Memb. K. p. 292; Fowl. l. c., p. 155, pl. 9, f. 18; Buckt. l. c., pl. 60, f. 2; Baker, Can. Ent. xxxix, p. 114. Mex; C. A; Pan; Tena, Ecuad.

Genus **QUADRINARIA**

Goding, Jour. N. Y. Ent. Soc. xxxv, p.

KEY TO SPECIES

One piceous and brown species, with lateral margins pronotum yellow anteriorly, posterior process brown, a large U-shaped mark reaching to both lateral margins and opening forward, and a narrow oblique band each side before apex, lemon-yellow; tegmina opaque brown, apical cells hyaline. *u-flava.*

LIST OF SPECIES

u-flava Godg. l. c., p. 168. Hill Gardens, Mona, Jamaica.

Genus **MARSHALLELLA**

Goding, l. c., p. 168.

KEY TO SPECIES

One beautiful creamy-white species, head and dorsum shining black, densely punctured and sculptured, legs bright scarlet; tegmina clear hyaline, shining; veins, bases of clavus and corium black, punctured, a short narrow yellow stripe and large scarlet spot near bases.................................*rubripes.*

LIST OF SPECIES

rubripes Godg. l. c., p. 169. Cinchona, Jamaica.

Genus **ORTHOBELUS**

Stal, Hem. Fabr. ii, p. 48.

KEY TO SPECIES

1 (2). Pronotum with suprahumerals long, strong, summits abruptly and lengthily recurved ....*urus.*
2 (1). Suprahumerals short, acute, conical, slightly recurved.
3 (4). Suprahumerals shorter, hind margins not serrated, posterior process straight, apex lightly recurved, long as abdomen; ground color black to brown, larger ....*havanensis.*
4 (3). Suprahumerals longer, hind margins serrated, posterior process sinuate, shorter than abdomen; ground color ferruginous, suprahumerals black; smaller ....*poeyi.*

LIST OF SPECIES

urus Fairm. l. c., p. 516, p. 13, f. 16; Buckt. l. c., pl. 55, f. 2; *megaceros* Walk. List p. 615; *labatus* Buckt. l. c., p. 239, pl. 55, f. 1. Mt. Cabrite, Haiti; Rep. Dominica.
havanensis Fairm. l. c., p. 516; Guer. Hist. Cuba, Ins., Sagra, p. 433; Met. & Brun. l. c., p. 207, pl. 1, f. 16 and 17. Cuba.
poeyi Fairm. l. c., p. 518; Guer. l. c., p. 433. Cuba; Mt. Cabrite, Haiti.

Genus **DAIMON**

Buckton, l. c., p. 240.

KEY TO SPECIES

1 (2). Posterior pronotal process shorter than abdomen, dorsum of uncinate apex rounded anteriorly; tegmina hyaline, bases and apical cells fuscus; dark ferruginous, legs concolorous. *serricornis.*

2 (1). Posterior pronota 1 process long as abdomen, dorsum of uncinate apex angulate anteriorly; tegmina piceous with 2 widely separated transverse hyaline bands; piceous, legs yellow........*satyrus.*

LIST OF SPECIES

serricornis Walk. Ins. Saund. Hom. p. 77. Port-au-Prince, Mts. above Carrefour, Haiti.

satyrus Buckt. Mon. Memb. p. 241, pl. 55, f. 4. Port-au-Prince.

These species, which had not been recognized since they were described, were received from Mr. G. N. Wolcott, Entomologist Department of Agriculture, Haiti; Mr. W. E. China kindly compared the types.

Genus BRACHYCENTROTUS

Metcalf & Bruner, Bul. Brook. Ent. Soc. xx, p. 211; idem, xxi, p. 28.

KEY TO SPECIES

1 (2). Black; head short; pronotum well elevated, median carina obscure, 3 globose dorsal elevations posteriorly; posterior process strongly depressed; scutellum broad, half as long and nearly covered by posterior pronotal process; legs only densely hirsute. *punctatus.*

2 (1). Yellowish-brown; head elongate; pronotum broad, depressed, apex distinctly carinate; scutellum small; generally hirsute. *hirsutus.*

LIST OF SPECIES

punctatus M. & B. l. c., p. 212, pl. 1, f. 5 and 6. Pico Turquino, Sierra Maestra, Cuba.

hirsutus M. & B. l. c., p. 213. Camaguey, Cuba.

Genus MONOBELUS

Stal, Hem. Afric. iv, p. 87; Hem. Fabr. ii, p. 47; *Delaunya,* Leth. An. Soc. Ent. Belg. xxv, p. 17.

KEY TO SPECIES

1 (10). Black, posterior pronotal process concolorous, or fuscous with apex black; tegmina with base black, yellow fasciate.

2 (5). Small; front transversely impressed; posterior process irregularly punctured, base rather broad; tegmina semitransparent.

3 (4). Pronotum black, posterior process tricarinate, the carinae abbreviated anteriorly ....*fasciatus.*

4 (3). Pronotum paler, fuscous punctured, posterior process unicarinate, apex black; tegmina with base black and yellow basal fascia. *irroratus.*

5 (2). Larger; front not or obsoletely impressed transversely; posterior process more slender; tegmina blackish.

6 (9). Median carina elevated and compressed posteriorly, posterior process tricarinate.

7 (8). Head broad, transverse, obsoletely impressed; pronotum black, humerals paler, posterior process not laterally impressed behind scutellum; basal fascia of tegmina faintly indicated. *turquinensis.*

8 (7). Head elongate, clypeus prominent, front margin broadly rounded; pronotum with yellow markings; posterior process strongly impressed laterally, strongly elevated in an obscure crest above scutellum; tegmina opaque, cells yellow centrally..............*niger.*

9 (6). Median carina of pronotum arcuate, posterior process not impressed or carinate; head produced downward..................*nasuta.*

10 (1). Pronotum black, lateral margins yellowish; apex of head obtusely rounded.

11 (12). Front margin of head strongly suddenly inflexed, lengthily concave; lateral margins of pronotum narrowly yellowish anteriorly ....*obtusiceps.*

12 (11). Front of head produced downward, or rounded; lateral margins pronotum broadly yellowish, leaving a narrow black line at middle; base of clavus black, sordid white fascia near base of corium.

13 (14). Small; head obtusely rounded, apical margin and front yellowish, front obliquely inflexed not freely produced downward; posterior pronotal process lightly punctate............................*flavidus.*

14 (13). Larger; head obtusely rounded, apical margin yellowish to eyes, front strongly inflexed, depressed; posterior pronotal process distinctly fuscus punctured; color variable......................*lateralis.*

List of Species

fasciatus Fabr. Syst. Ent. Suppl. p. 515; Syst. Rh. p. 22; Stal. Hem. Fabr. ii, p. 47; Met. and Brun. l. c., p. 209. *2-guttatus* Fabr. Syst. Rh. p. 21. Pico Turquino and Camaguey, Cuba; Kenscoff, Haiti; Porto Rico.

irroratus M. & B. l. c., p. 211, pl. 1, f. 15. Camaguey, Cuba.

turquinensis M. & B. l. c., p. 210. Taco Taco, Pico Turquino, Cuba.

niger M. & B. l. c., p. 210, pl. 1, f. 9. Camaguey, Taco Taco, Cuba.

nasuta Stal. Hem. Fabr. ii, p. 50; *fasciatus* Leth. An. Soc. Ent. Belg. xxv, p. 17. Guadeloupe, W. I.

obtusiceps Stal. Mem. Fabr. ii, p. 50. Hab: ? West Indies.

flavidus Fairm. l. c., p. 519; Met. & Brun. l. c., p. 209, pl, 1, f. 1. Taco Taco and Candelario, Cuba.

lateralis Stal, Hem. Fabr. ii, p. 50; Met. & Brun. l. c., p. 209. Camaguey, Cuba.

PLATE XIX

The drawings were prepared by Mr. W. E. China, of the British Museum, from Walker's types in that institution.

Nicomia obliqua Walk.

Fig. 1. side view; Fig. 2. dorsal view; Fig. 3, tegmen; Fig. 4. head.

Nicomia obliqua Walk.

Fig. 5. dorsal view; Fig. 6. side view; Fig. 7. head; Fig. 8. tegmen; 9. wing.

Mina aliena

Fig. 10. dorsal view; Fig. 11. front view; Fig. 12. side view; Fig. 13. tegmen; Fig. 14. wing.

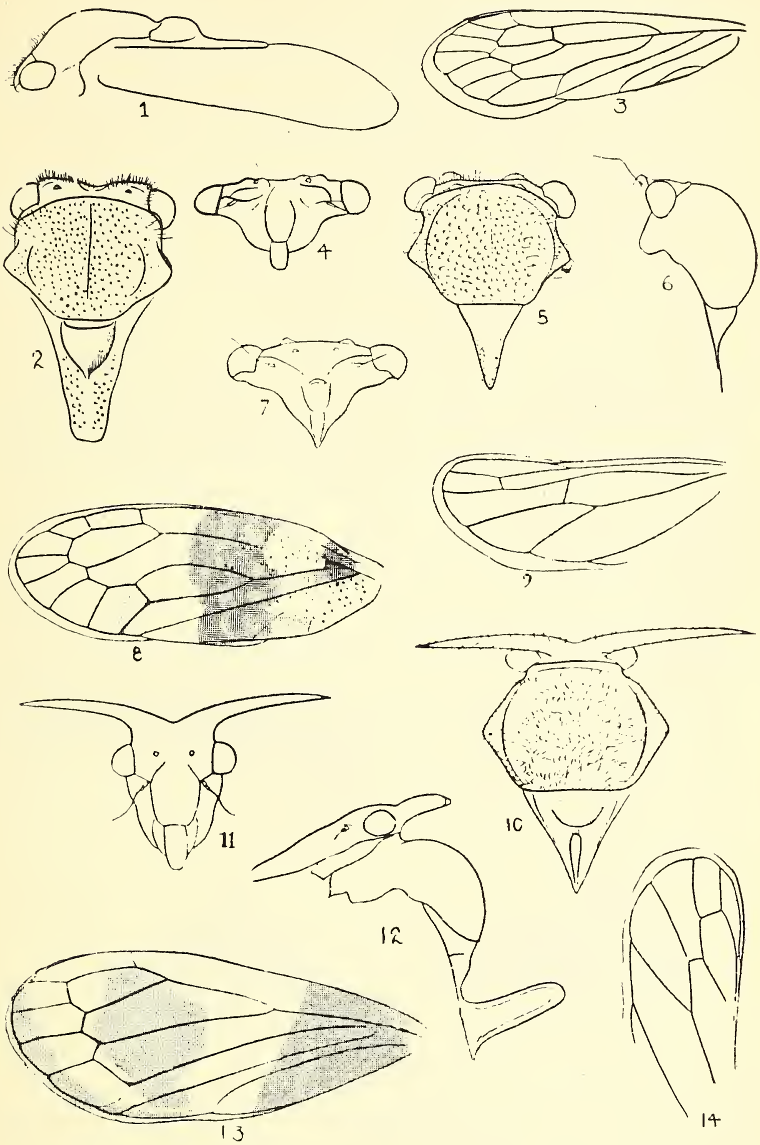

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PLATE XX

Walkeria latipes Walk.

Fig. 15. dorsal view; Fig. 16. side view; Fig. 17. front view of head; Fig. 18. apex of pronotum with scutellum; Fig. 19. tegmen; Fig. 20. damaged wing.

Stegaspis aperta Walk.

Fig. 21. side view.

Stegaspis insolita Walk.

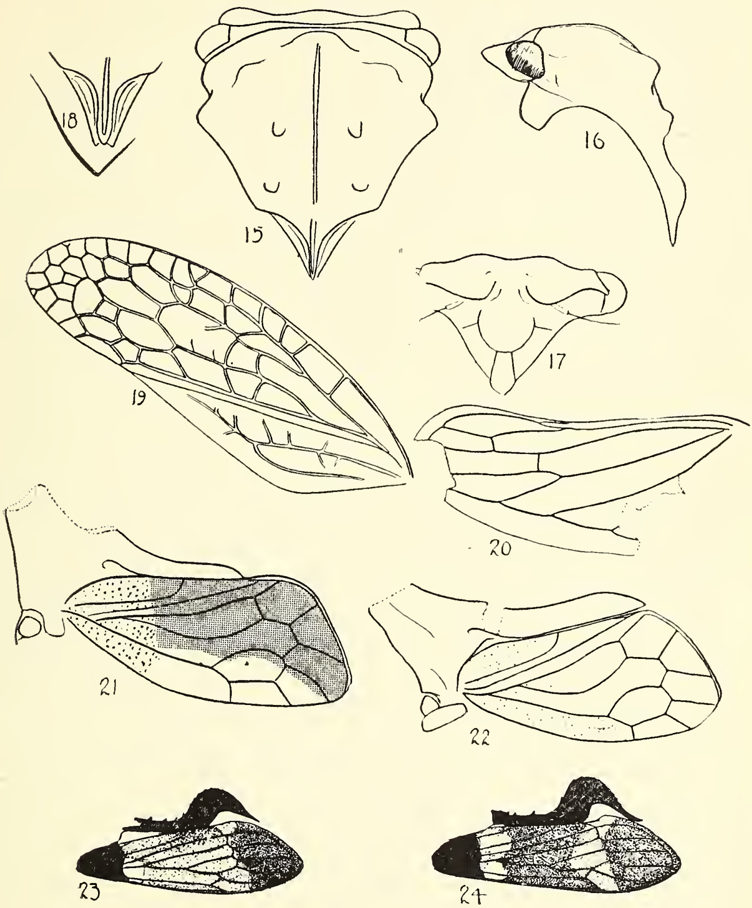
Fig. 22. side view.

Daimon serricornis Walk.

Fig. 23. tegmen and posterior pronotal process.

Daimon satyrus Buckt.

Fig. 24. tegmen and posterior pronotal process. The figure does not show the acute angle on the dorsum of the uncinate process anteriorly.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JAMES PETIVER'S GAZOPHYLACII

BY HARRY B. WEISS
NEW BRUNSWICK, N. J.

During the end of the seventeenth and the beginning of the eighteenth century, the apothecaries sold "good cordials," "powders of Kent, Zell, and Contrajerva," "human skull and hartshorn," "essence of ambergris," "essence of viper," "commendeur balsam for apoplexy," "spirit of white cochlearia," "honey water," "orange flower water," and "arquebusade." They also prescribed for minor ills and some charged outrageous prices for their pills. It was during these good times, when the apothecaries were highly thought of for having stuck to their mortars and sold remedies during the Great Plague of London in 1665 when most of the doctors had fled, that James Petiver flourished—as an apothecary, as a botanist and as an entomologist. Although there is nothing to indicate that he charged a dollar for a pearl julep or thirty dollars for a pill "and the same for an apozeme" as did some of his colleagues, it is recorded that he had a good practice and advertised quack remedies. However, he was not alone in this, as all sorts of nostrums were sold then as now, and Charles II, in an effort to relieve suffering humanity, purchased from Doctor Goddard the formula of a catholicon, the chief ingredient of which was dried human bones.

According to the "Dictionary of National Biography," Petiver was born between 1660 and 1670 at Hillmorton, near Rugby, and received his early education at the Rugby free school. About 1683 he was apprenticed to an apothecary to St. Bartholomew's Hospital, London, and by 1692 he had his own business at White Cross, near Long Lane, in Aldersgate Street, where he lived the rest of his life. He was interested in both insects and plants, and his collection of the latter had by 1697 reached a total of between 5,000 and 6,000. He corresponded with John Ray, botanized with Samuel Doody and Adam Buddle around Hampstead, accompanied James Sherard to Cambridge in 1715, went to Ley-

den in 1711 to buy Doctor Hermann's museum for Sloane, and made many other trips. In 1695 he was elected fellow of the Royal Society, and from 1709 he was demonstrator of plants to the Society of Apothecaries.

He published some twenty-three items and contributed twenty-one papers to the Philosophical Transactions. His first publication was "Museum Petiverianum" (1695–1703) in "ten centuries," each of which dealt with the descriptions of one hundred plants, animals, and fossils. This was followed by five folio decads of ten plates each (1702–1706) under the title of "Gazophylacium," the first volume being accompanied by a small 8 vo Catalogue. In 1711 the second volume containing five additional decads and a Catalogue of four folio pages appeared.

All of Petiver's papers except those which appeared in the "Philosophical Transactions" were republished in 1764 (2 vols. fol. and 1 vol. 8 vo.) under the title, "Jacob Petiveri opera historiam naturalem spectantia; or Gazophylaceum containing several 1000 Figures of Birds, Beasts, Reptiles, Insects, Fish, Beetles, Moths, Flies, Shells, Corals, Fossils, etc., from all Nations on 156 Copperplates, with Latin and English Names" (London). In 1767 another edition appeared with "above three hundred Copper-Plates, with English and Latin Names. The additions corrected by James Empson."

The single folio volume of Petiver's works in the library of the American Museum of Natural History contains the following nine items. His "Pterigraphia Americana Icones" consists of a list of some four hundred names of ferns, lichens, fungi, shells, sponges, coral, etc., and a few insects, from Antego, Barbados, St. Christopher, Nevis, Jamaica, etc., illustrated by twenty plates. His insects include ichneumon flies, horse flies, bee flies, stone flies and wasps. Then follows a "Catalogue of Mr. Ray's English Herbal" with fifty plates figuring the flower, seed capsule, leaves and roots of some six hundred species, together with brief notes concerning their colors, time of blooming, habitats, etc. Another is entitled "Gazophylacii Naturae & Artis." This is made up of five parts with fifty plates and is a descriptive catalogue of the animals, fossils, birds, shells, plants, etc., found in England, Spain, India, Persia and Brazil. A few illustrations

of insects such as wasps, butterflies, beetles, walking sticks, etc., are scattered over the plates without any particular arrangement. The text is very brief and appears, at this time, quite unsatisfactory. Under "Brazil Insects" (Tab. LX) number 3 is described as "A stinking sort of Bug with a yellow Head and green Sheath-wings streak'd underneath with black," and number 5 as a "Steel wasp. Paipai guacu Brasil. A sort of Wasp or Hornet shining like polisht Steel." His other descriptions of animals, plants, etc., are just as brief, and supposedly the illustrations were to be used in identifying the species. Another short paper is "Plantarum Ægyptiacarum rariorum Icones," with two plates, a catalogue of rare Egyptian plants. His "Aquatilium Animalium Amboinae Icones & Nomina," with twenty plates, contains "near 400 Figures, engraven on Copper Plates of Aquatick Crustaceous and Testaceous Animals: as Lobsters, Crawfish, Prawns, Shrimps, Sea-Urchins, Eggs, Buttons, Stars, Couries, Concks, Perywinkles, Whelks, Oysters," etc., "all found about Amboina, and the Neighbouring Indian Shores, with their Latin, English, Dutch, and Native Names." The plates are dedicated to the various persons who supplied him with specimens and notes. Petiver's "Papilionum Britanniae Icones Nomina, &c.," illustrates over eighty English butterflies on six plates, although three of these are missing from the American Museum's copy. As usual the accompanying descriptive text is brief. Attention is called to characteristic markings, color, etc., and sometimes habits and host plants are mentioned. As a rule two or three lines of text are all that accompany each species. For example, Fig. 13, Tab. VI, is characterized as "Papilio minor supernè fuscus, infernè viridis. Holly Butterfly. Because I first observed it on that tree," and Fig. 2, Tab. V, as "Papilio Oculatus Hampstediensis, ex aureo fuscus. Albin's Hampstead Eye. Where it was caught by this Curious Person, and is the only one I have yet seen." The balance of the Museum's copy is made up of fifty plates (on some of which insects are illustrated) without explanatory text and Petiver's "Plantarum Italiæ, Marinarum & Graminum, Icones, Nomina, &c." with five plates. Petiver's papers which appeared in the "Philosophical Transactions" between 1697 and 1717 deal mainly with exotic plants, animals,

minerals, fossils and drugs which he exhibited, and which he received from his friends in foreign countries. To mention only the insects, from Maryland he received click beetles, ''cantharis'' and several species of ''Scarabeus,'' sent by the Rev. Mr. Hugh Jones, from East India, beetles, crickets, butterflies sent by Mr. Edward Bulkley, Surgeon, and from the Philippine Islands, butterflies, sent by the Reverend Father George Joseph Camel. He also published in the Transactions (No. 331, 1711) part of a letter he had received from van Leeuwenhoek on the ''Animalcula Semine of Young Rams.''

Petiver died about April 2, 1718, and his collection and books which were purchased by Sloane are now in the British Museum. It is stated that although he was a good observer his botanical statements are frequently inaccurate. Altogether it does not appear that anything in Petiver's old folios is worth reprinting in new quartos, and his works are now as lifeless as most scientific writings eventually become.

BOOK NOTICES

Guide to the Insects of Connecticut. Part V. The Odonata or Dragonflies of Connecticut. By Philip Garman, Ph.D. Published as Bulletin No. 39 by the State Geological and Natural History Survey. 1927. 331 pp., 22 plates, 67 text-figures, bibliography, glossary and index.

Students of North American dragonflies have been, as a whole, fortunate in the past in having the group treated in a painstaking and careful manner, and the present book is a continuation of this good fortune.

The following subjects are treated in the introduction: habits and life history, parasites and enemies, general characters of the Odonata, external anatomy, how to distinguish the sexes, variability, collecting and preserving. Then follows the taxonomic part in which there are tables and descriptions covering 164 species, 112 of which are recorded from Connecticut. The numerous figures greatly help in the determination of the species.

The book will be found very useful to a considerable number of entomologists as the species of dragonflies often have a wide distribution.—WM. T. DAVIS.

Histological Technique. A Guide for Use in a Laboratory Course in Histology. By B. F. Kingsbury, Ph.D., M.D. and O. A. Johannsen, Ph.D. N. Y. John Wiley & Sons, Inc. 1927. 142 pp., 16 illustrations, references and index. Price, $2.25 net.

This book should be very useful to the average entomologist, amateur or otherwise, giving him detailed instruction in the best way of preparing and preserving his material for certain purposes. The subjects covered are fixation with list of fixers, isolation, sectioning and imbedding, staining, mounting, sealing and labeling, the microscope and accessories, special methods for various animal forms. Under the last heading are instructions for the treatment of spiders, myripods, Collembola, neuropteroids, scale insects, aphids, Lepidoptera, Diptera, Coleoptera and Hymenoptera.—WM. T. DAVIS.

ALEXANDER NECKAM, CLERGYMAN AND NATURALIST OF THE TWELFTH CENTURY

Although he was the foster-brother of Richard Coeur de Lion, Alexander Neckam (1157–1217) managed to obtain some fame of his own in the field of learning. According to Wright[1] he taught school at Dunstable, studied and taught at Paris, traveled some, joined the Augustinians, and became abbot of Cirencester in 1213. Neckam's interests were broad, embracing theology, medicine, law and the liberal arts, and his numerous writings, most of them still in manuscript, include works on classical mythology, grammar, the Bible, Aristotle and literary and scientific treatises. He thought quite highly of scientific effort, and in a passage in his ''De Naturis Rerum'' states that ''Science is acquired at great expense, by frequent vigils, by great expenditure of time, by sedulous diligence of labor, by vehement application of mind.'' Nor did he shrink from all of Aristotle's scientific theories, in spite of his clerical training.

According to Wright, Neckam's ''De Naturis Rerum,'' or ''The Nature of Things,'' may be looked upon ''as an interesting monument of the history of science in Western Europe and especially in England during the latter half of the twelfth century,'' although written in a saintly and moralizing style. Natural phenomena are described, such as the spots on the moon, vacuums, planets, medieval inventions, etc., and according to Gunther,[2] ''In his choice of animals Neckam selected such as were neither too commonly known to the vulgar, nor totally unknown. Beginning with the crocodile, serpent, rhinoceros, viper, toad, weasel, fox, ape, bear, wolf, deer, camel, elephant, dragon, lion, onager, and hyena, he reaches the 'noble animal' man, with an interesting disquisition on sight, and refraction and reflection of light by glass mirrors. He explains that since man withdrew his obedience from his Creator, the obedience of the greater

[1] De Naturis Rerum, edited by Thomas Wright, 1863, London.

[2] Early Medical and Biological Science. Oxford, 1926.

number of wild animals has been withdrawn from him; but to reprove and abate his pride, the power of tormenting him has been given to some of the most insignificant of animated things. Gnats attack him in the eyes . . . ; fleas disturb his sleep at night and his contemplations by day; flies intrude into the liquors he drinks and into the food he eats. Moreover, if man had not sinned, there would have been no venomous or poisonous thing on the earth. After this discourse on Man, he proceeds to treat of domestic animals including bees and silkworms, given to man after the Fall out of compassion for the human race."

Wright states that much of Neckam's for the most part credulous animal accounts was taken from the writings of Solinus, Isidore and Cassiodorus, but Thorndike[3] calls attention to the fact that in many passages, Neckam cites no authorities, and in such cases he should be given credit for his originality. Gunther says that Neckam added many of his own observations. Cassiodorus (circa 497–575), a philosopher and man of letters, was governor of Sicily and secretary to Theodoric and Solinus, who lived supposedly during the time of Augustus, was a Latin grammarian whose "Polyhistor" contained so many extracts from Pliny, in Pliny's style, that it earned for him the name "Ape of Pliny." Isidore, who lived from about 560 or 570 to 636, and was bishop of Seville about 600, was the author of a dictionary known as the "Etymologiæ" in which the words are arranged under subjects. Like most dictionaries, it was largely a compilation. Neckam alludes frequently to Aristotle, Euclid, Plato, the church fathers, Augustine, Jerome, Basil, Gregory, etc., and for his time his knowledge was considerable, although it included many things that are now regarded as absurd.

In a religious manuscript by Neckam still extant at Oxford, there is a closing statement, the first sentence of which is: "Perchance, O book, you will survive Alexander, and worms will eat me before the book-worm gnaws you,"[4] which is exactly what happened.—HARRY B. WEISS.

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[3] History of Magic and Experimental Science, 1923, New York.

[4] Thorndike, *l. c.*

PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY

MEETING OF JANUARY 4, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., in the American Museum of Natural History; President Frank E. Lutz in the chair with nineteen members, and five visitors present.

The treasurer presented his annual report, audited by Mr. Bell, viz:

Balance January 1, 1926		$1,167.84
Receipts from dues		313.50
Receipts from income		56.33
Receipts from sales and subscriptions		845.42
		$2,383.09
Paid for lantern	$ 37.75	
Paid for sundry expenses	10.18	
Paid for Journal	1,265.40	1,313.33
Balance January 1, 1927		1,069.76
Plus Permanent Fund, present value		973.92

Total membership 1 Honorary, 5 Life, 118 Regular = 124.

Total Subscribers 107 Members, 47 Individual, 96 Institutions = 250.

The treasurer's report was accepted with thanks.

The librarian reported accessions.

The program committee reported W. W. Bowen as speaker at the next meeting.

The nominating committee submitted nominations for officers in 1927: There being no other nominations an affirmative ballot was cast by the secretary, thereby electing President, Henry Bird; Vice-president, A. H. Sturtevant; Secretary, Charles W. Leng; Treasurer, Wm. T. Davis; Librarian, Frank E. Watson; Curator, A. J. Mutchler; Executive Committee, H. G. Barber, E. Shoemaker, Herbert F. Schwarz, H. Notman, G. C. Hine; Publication Committee, Harry B. Weiss, F. E. Lutz, John D. Sherman, C. E. Olsen; Delegate to New York Academy of Sciences, Wm. T. Davis.

Dr. Lutz, as retiring president, thanked the members for their support during his incumbency, and surrendered the chair to Mr. Bird.

Mr. Bird after recalling the number of years he had been a member and expressing his appreciation of Dr. Lutz' service, spoke of the recent meeting in Philadelphia and the many inquiries made there about Mr. Davis whose popularity with the ladies was manifest.

On motion of Mr. Mutchler the purchase of an extra bulb for the lantern was approved.

Mr. Davis presented a photograph and autobiographical sketch of Professor Francis Fillion, now 76 years old.

Mr. Barber showed the first number of a new Japanese Entomological Journal.

Mr. Leng showed the first number of Biological Abstracts.

Mr. Angell suggested establishing the new office of Historian but it was thought that such duties could be performed by the curator with help from Mr. Wunder.

Mr. Notman spoke on ''Collecting at Devil's Lake, N. D., and Great Salt Lake, Utah,'' illustrating his remarks with a great collection of the little beetles he had found on the shores of these saline lakes, all most carefully mounted and labeled. These collections were made in 1923 as part of an automobile journey to Oregon and return. Devil's Lake, at an elevation of 1,469 feet is about 60 miles long and 15 miles wide in places, with a wide beach, quite stony a little way from the water; or with woods of which the undergrowth is dense. Great Salt Lake is at an elevation of 4,210 feet and the beach is, where Mr. Notman collected, covered with dry vegetable matter like wood pulp which may be pulled up in sheets. Tiger beetles peculiar to these salt lakes were shown from both localities but the greatest attention was paid to the small Carabidæ which abounded, especially *Bembidion* of which enormous series were shown. Mr. Notman commented upon the variety of habits exhibited by the different species of this large genus and the late Col. Casey's theory that it was geologically a young and growing genus. He was complimented by the president at the close of his remarks.

Mr. Nicolay under the title, ''Boreal Coleoptera at Greenwood Lake'' gave a résumé of his summer's collecting at Greenwood Lake, Orangeburg, Point Pleasant, and Washington. The most interesting feature was the finding in the pines on the summit of the hills on the western side of the lake opposite Sterling Forest of several buprestids, *sulcicollis* a dark form of *salisburyensis*, and *striata*. Mr. Nicolay expressed his obligations to Mr. Schott for pointing out the spot.

Mr. Shoemaker said the Elateridæ found there were quite as remarkable as the Buprestidæ.

Mr. Angell exhibited young mantids hatched in the house from egg masses collected at Point Pleasant.

Dr. Leonard exhibited galley proofs of the New York State List of Insects saying that its publication in May was hoped for. It would be called Cornell Memoir 99 and contain about 1,000 pages.

Mr. Ragot exhibited a duplex killing jar he had devised by which the carbona in one jar reached the insect in the other through a wire mesh.

The President appointed the following committees: Program, Messrs. Mutchler, Weiss and Sturtevant; Field, Messrs. Nicolay and Shoemaker; Auditing, Messrs. Bell, Lawler, and Janvrin.

MEETNG OF JANUARY 18, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., in the American Museum of Natural History; President Henry Bird in the chair with twenty-four members, and nine visitors present.

The program committee reported Messrs. Huntingdon and Shoemaker as speakers for the next meeting.

Dr. Lutz exhibited catalogue of the Woodruff Library, appraised by Mr. Sherman, from which members are entitled to purchase at 50 per cent. discount.

On motion Dr. Lutz was requested to continue to act for the Society.

Mr. R. J. Sim, Japanese Beetle Laboratory, Riverton, N. J., and Mr. C. Thoroman, Houston House, 109 Houston St., N. Y., were elected members of the Society.

Mr. W. W. Bowen spoke on ''Problems of an Entomologist in the Sudan,'' with illustrations by lantern slides. The insects discussed were *Heliothrips indicus, Schistocera gregaria,* of which *S. flaviventris* was said to be a sedentary phase, and three species of bollworm. The damage to the cotton crop and the control measures recommended were features of Mr. Bowen's remarks and illustrations, which disclosed the progress made by the introduction of scientific methods.

Mr. Davis read the following memo showing the introduction of silkworm eggs in 1657.

May 26, 1657. Letter. Directors to Stuyvesant from Amsterdam mentions mulberry trees.

December 22, 1657. Letter. Directors to Stuyvesant from Amsterdam mentions ''silk worm seed sent to New Netherland.''

Dutch manuscripts pp. 283–284.

Calendar of Historical Manuscripts in the office of the Secretary of State, Albany, N. Y. E. B. O'Callaghan, 1865.

He exhibited a ''Treatise on the Rearing of Silkworms'' translated from the German of Mr. de Hazzi, of Munich, published April 21, 1828, by order of Congress.

MEETING OF FEBRUARY 1, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., February 1, 1927, in the American Museum of Natural History, President Henry Bird in the chair, with nineteen members and three visitors present.

Dr. Lutz read correspondence with the representive of the Woodruff estate, and reported what arrangements had been made with respect to the disposal of the Woodruff library.

The program committee reported Messrs. Jones and Hartzell as speakers for the meeting of February 15.

On motion, the resignation of D. M. Cammann was accepted.

Mr. Davis read a letter from Mr. Leng, reporting his safe arrival in Porto Rico.

Mr. E. L. Huntingdon spoke on ''A Trip to Southeastern Wyoming.'' The speaker collected at Diamond Ranch, near Chugwater, Wyoming, in July and August. The type of country visited was illustrated by photographs. Notes were presented on various groups of insects, more particularly on Lycaenidae. Lists of species taken were passed around, showing 53 Coleoptera and 40 Lepidoptera. Specimens of Odonata and Orthoptera (partly identified by Mr. Davis) were also exhibited.

The paper was discussed by Messrs. Barber, Notman, Davis and Shoemaker.

Mr. Ernest Shoemaker spoke on ''Some Lepidoptera and Coleoptera taken at Canadensis, Pa., during the past season.'' Collecting was done during July and September. Twenty species of butterflies (excluding skippers) were taken; numerous notes were presented on these and various moths. About 150 species of beetles were taken. Of these *Dialytes ulkei* and *Necydalis mellita* were specially notworthy. Many of the specimens taken were exhibited at the meeting.

The paper was discussed by Messrs. Bird and Davis.

Mr. Ballou, present as a visitor, spoke of collecting experiences in Cuba, more especially concerning a trip to the high mountains in the eastern part of the islands. His account included remarks on stingless bees, beetles and tabanid flies, as well as a description of the country. A very large proportion of the species collected were previously unknown.

These remarks were discussed by Messrs. Davis, Sherman and Mutchler, the latter corroborating Mr. Ballou's report on the high frequency of new species in his material.

Mr. Ragot recorded a few 1927 captures (Coleoptera, Aptera), with some remarks on winter collecting in cities.

Meeting of February 15, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., February 15, 1927, at the American Museum of Natural History, President Henry Bird in the chair, with twenty-two members and six visitors present.

Dr. Lutz reported the receipt of a check for $10,000 from the estate of L. B. Woodruff. To facilitate the receipting for this amount, the following resolution was read, and, on motion, was adopted. ''Resolved (1) that Frank E. Lutz be and hereby is authorized to sign for the New York Entomological Society any and all papers required in Matter of the Judicial Settlement of the Account of Proceedings of James P. Woodruff as Executor of the last Will and Testament of Lewis B. Woodruff, deceased; and (2) that, in the absence of Charles W. Leng, Secretary, A. H. Sturtevant be and hereby is appointed Secretary *pro tempore.*''

On motion by Dr. Lutz, it was also voted that the provisions of the Woodruff will concerning this amount be entered in the minutes of the Society. These provisions are as follows: ''I give and bequeath to the New York Entomological Society (Inc.) the sum of Ten thousand dollars ($10,000)

to be added to its "Permanent Fund." While intending in no way to impose upon said Society any conditions with respect to this gift, or any binding restrictions respecting the use of the income derived therefrom, I would suggest that this legacy be invested in some conservative income producing property or securities, and that its income be devoted primarily to the publication of technically illustrated monographs within the field of the Society's present authorized activities, such income to be allowed to accumulate, if necessary, to that end; and that a memorandum of this suggestion, if it meets with the Society's approval, be filed with the permanent records of its treasurer."

It was further voted that the final investment of this money be made subject to action by the executive committee of the Society.

The program committee reported Messrs. Engelhardt and Johnson as speakers for the next meeting.

Mr. Engelhardt called the attention of the members of the Society to the revival of the publication "Entomologica Americana" by the Brooklyn Entomological Society.

Mr. Frank M. Jones read a paper on "The Mating of the Psychidae, a Photographic Record." The speaker reviewed the literature on the mating and reproduction of the psychid moths. Certain European members of the group reproduce by parthenogenesis, but this must be rare if it occurs at all with our local species. The common *Thyridopterix ephemeraeformis* has been much studied, but the method of mating was still uncertain. Using much material, and new methods (more especially instantaneous fixation of mated pairs by plunging them in boiling water), the speaker was able to show that mating occurs by means of great elongation of the male abdomen. The male genitalia are then brought into direct connection with the genital opening of the grub-like female, within the split pupa case of the female. These results were illustrated by photographs, lantern-slides and preserved specimens.

Dr. Albert Hartzell read a paper on "The Leaf-Hoppers of Economic Importance in our Local Fauna." Of the 175 species recorded from New York State, the speaker estimated that about 40 to 50 are abundant enough to be of economic importance. The damage done is of two kinds—that resulting directly from sucking plant juices, and that resulting from the fact that certain species serve as carriers for plant diseases. Two hoppers of the latter class were discussed in more detail: *Empoasca fabae*, which carries the virus of "hopped-burn" of potatoes, and *Cicadula 6-guttata*, carrier for "aster yellows."

The paper was illustrated by photographs and specimens.

MEETING OF MARCH 1, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., on March 1, 1927, in the American Museum of Natural History, President Henry Bird in the chair, with twenty-six members and nine visitors present.

The treasurer reported the receipt on February 15, 1927, of the $10,000 bequest from Lewis B. Woodruff, which was handed on February 16, 1927, to the Farmers' Loan and Trust Company, who have charge of the Permanent Fund of the Society, and from whom the following Declaration was received, viz.:

The Farmers' Loan and Trust Company hereby declares that it has received an additional sum of Ten thousand dollars ($10,000) which it holds and will hold as Trustee pursuant to the terms of a declaration of trust executed by it June 1, 1927, for the benefit of the New York Entomological Society and which sum shall be added to the Permanent Fund of said Society.

[Signed] THE FARMERS' LOAN AND TRUST COMPANY,
by J. G. Kilbreth,
Assistant Trust Officer

The treasurer delivered the original Declaration of June 1, 1927, to be deposited in the American Museum of Natural History, a copy thereof being printed in the JOURNAL for December, 1917, Vol. XXV, pp. 197–198, and called attention to the fact that its terms had been approved by a committee of which Mr. Woodruff was a member as shown by the minutes of May 15, 1917 (Vol. XXV, p. 240). He also delivered the Farmers' Loan and Trust Company's receipt for the check of $10,000.

Mr. Hall, for the Executive Committee, reported the following resolution which was adopted: Whereas the American Museum of Natural History, through their officials, have aided materially with the legal processes involved in the settlement of the bequest of Lewis B. Woodruff, deceased, to the New York Entomological Society:

Be it resolved:

That the New York Entomological Society herewith express their appreciation of the cordial attitude of the Museum, and of the very material service rendered in this matter, and beg to tender herewith their recorded vote of thanks to the Museum.

[Signed] HENRY BIRD, GAYLORD C. HALL, HOWARD NOTMAN, HERBERT F. SCHWARZ, HARRY G. BARBER.

The resignation of Miss Irene Dobroscky was accepted with regret.

Mr. H. F. Schwarz spoke of the next issue of the Directory of the Scientific Alliance and, on motion by Mr. Sherman, the Society voted to bear its proportionate share of the expense of printing.

Mr. Mutchler announced that the books ordered by members from the Woodruff Library were ready for delivery.

Mr. Frank Johnson spoke of "Protective Mimicry of the Undersides of Butterflies' Wings." He exhibited four cases of *Morpho* and other tropical species, and showed how the coloration resembled the localities in which each would be found. From his own experiences in collecting he was able to do this in great detail and show how the color of the underside was always protective.

Mr. Engelhardt spoke of "The Romance of Life-History Hunting in the Clear-wing Moths (Aegeriidæ)." After reference to the work of Mr. and Mrs. Beutenmuller, Joutel, and others he told how he had devoted himself for years to the study of the life history. Two boxes were exhibited as illustration of the work done by the larvae. About forty life histories had been traced, showing that some species bore in solid wood, others in branches, stems, roots, etc., the whole affording interesting experiences and adding materially to our knowledge of the group, which occurs across the continent, from Mexico to Alaska and sea level to the mountain tops.

In the discussion following his remarks, in which Messrs, Schwarz, Lemmer and Sherman took part, the latter, in lighter vein, told how an auctioneer had once offered Mr. Beutenmuller's monograph as a treatise on Seaside Moths.

MEETING OF MARCH 15, 1927

A regular meeting of the New York Entomological Society was held at 8 P. M., March 15, 1927, in the American Museum of Natural History; President Henry Bird in the chair with thirty-four members, and twenty-seven visitors present.

The regular order of business was by unanimous consent suspended and Dr. Leland O. Howard, Chief U. S. Bureau of Entomology, was elected an honorary member of the Society by a rising vote.

The program committe reported Dr. Phillip Garman and C. W. Leng as speakers for the next meeting.

Dr. Sturtevant delivered an address "Observations on Slave-making Ants." He said in part: There are four slave-making forms of ants in the immediate neighborhood of New York City—*Formica sanguinea*, subsp. *rubicunda*, *F. sanguinea*, subsp. *subintegra*, *Polyergus lucidus*, and *Harpagoxenus americanus*. Specimens of these four forms, collected at Morristown, N. J., in the summer of 1926, were exhibited together with the usual slave species and some species occasionally found as slaves. The raids of *F. subintegra* and of *P. lucidus* were described, and attention was called to some of the problems not yet satisfactorily solved in connection with these raids.

Harpagoxenus americanus is a rare ant, whose habits were previously very imperfectly known. A report was given of experiments on colony-founding, the full account of which is to be published in a forthcoming issue of "Psyche."

Dr. Howard, under the title, "Some Observations on Entomology and Entomologists," spoke first of the International Entomological Congress to be held in Ithaca in August, 1928, and of the Washington Entomological Society whose greetings he brought to us. He then spoke of the appropriation necessarily made to counteract the ravages liable to be perpetrated by the European corn-borer, contrasting the helpless condition of this creature for seven months of the year with the superior wealth and intelligence of the human race, but pointing out that each female corn-borer being capable of

laying 700 eggs, our intelligence will not overcome her instinct unless used. He passed then to a number of instances of phoresy recently brought to light, cases in which the instinct of the parent secured a free ride on the appropriate host for the purpose of depositing eggs. Apart from the interest as a series of scientific observations there had been an important corollary in connection with spotted fever ticks.

Prompted by Dr. Lutz, Dr. Howard gave a résumé of the principal problems confronting his department, the cotton boll-weevil, the corn-borer, the Japanese bettle and gypsy moth, with 150 other projects also in progress. The drama of the cotton boll-weevil included ruined planters, the suicide of bankers, the exodus of starving Negroes, with the department struggling to induce the burning of dead stalks of the cotton plant and the planting of early maturing cotton. After describing the damage done by the four principal pests and the remedies he advised he closed with an account of arsenical dusting by aeroplanes at night at a cost of about $5.00 per acre.

Dr. Howard's address was followed with close attention and discussed by Messrs. Bird, Bagot, Engelhardt, Angell, Olsen and others.

Mr. Engelhardt called attention to the approaching 55th anniversary of the Brooklyn Entomological Society and the resumed publication of Entomologica Americana as well as the Bulletin.

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SUPPLEMENT

COLEOPTERA: Provancher 77 (Que.). (Delete Schiodte). Pierce 04:18 (genera of triunguloid larvae of Meloidae, Rhipiphoridae, Strepsiptera).
COLEOPTERA AQUATIC: Needham, Guide to the Study of Fresh Water Biology 27:28 (common fam. and genera of larvae).
CARABIDAE: Harpalinae Bisetosae: Bembidiini: Bembidion (s. lat.) Hayward 97:134 (n.e. N.A.).
AMPHIZOIDAE: Van Dyke, Pan-P. Ent. III, 27:197.
DYTISCIDAE· Ilybius Fall, Ent. News XXXVIII, 27:284. Copelatus Schaeffer 08:17.
HYDROPHILIDAE: Schiodte 61:30 (genera of larvae). Helochares- Helocombus, Helobata Winters, Pan-P. Ent. IV, 27:19-29. Sphaeridiinae Knisch, Arch. Naturg. LXXXV (A,'), 20:71 (genera).
STAPHYLINOIDEA Hatch, Univ. Minn. Agr. Exp. Sta. Tec. Bull. 48, 27:9-12 (fam. of adults and larvae).
SILPHIDAE: Silphinae Hatch 27:4-6 (adults and larvae of Minn.). Nicrophorus Barkowski, Ent. Rund. XXVII, 10:79. Catopinae Hatch 27:14-15 (genera of adults and larvae). Anogdus Hatch 27:17.
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CLERIDAE: Monophylla Wolcott 10:340. Trichodes Wolcott 10:367. Cregyra Wolcott 10:384. Orthopleura Wolcott 10:296.
RHIPIPHORIDAE: Macrosiagon Pierce 04:12. Rhipiphorus Pierce 04:9, Ent. News XXI, 20:277.
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Cossinae Horn 73:451-447. (Delete Rhyncolus)
Calendrinae Horn 73:407-430 (Delete Scyphophorus and Calendra Horn). Calendra Chittenden 04:128 (simplex group), 04:132 (venatus group).
STREPSIPTERA Pierce 04:13 (genera).

Correspondents will do a favor by transmitting to the author any other references that should be included in this supplement.